U.S. Army Corps of Engineers
Omaha District

Draft Technical Project Planning Memorandum
Camp Abbot
FUDS ID F10OR0041

Site Inspections at Multiple Sites, NWO Region Formerly Used Defense Sites, Military Munitions Response Program

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Shaw® Shaw Environmental, Inc.

9201 East Dry Creek Road
Centennial, CO 80112

Technical Project Planning Memorandum

Site Inspection
Camp Abbot
Formerly Used Defense Site
FUDS ID F10OR0041

Military Munitions Response Program

Documentation for Technical Project Planning Meeting
Sunriver Resort, Sunriver, Oregon
April 4, 2006

Hosted by U.S. Army Corps of Engineers

Prepared by Shaw Environmental, Inc.

May 8, 2006

Concurrences

USACE Omaha Design Center/Omaha District	_____ John Miller
USACE Seattle District	_____ William Graney
Oregon Department of Environmental Quality	_____ David Anderson
Shaw Environmental, Inc.	_____ Peter Kelsall

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ABBREVIATIONS AND ACRONYMS

AOC	area of concern
ASR	Archives Search Report
CSM	Conceptual Site Model
CWM	chemical warfare materiel
DoD	Department of Defense
DQO	Data Quality Objective
ERTC	Engineer Replacement Training Center
Forest Service	U.S. Department of Agriculture Forest Service
FS	Feasibility Study
ºF	degrees Fahrenheit
FUDS	Formerly Used Defense Site
GPS	Global Positioning System
HRS	Hazard Ranking System
INPR	inventory project report
MC	munitions constituents
MEC	munitions and explosives of concern
µg/L	microgram(s) per liter
mg/kg	milligram(s) per kilogram
mg/L	milligram(s) per liter
mm	millimeter
MRSPP	Munitions Response Site Prioritization Protocol
NDAI	No Department of Defense Action Indicated
ODEQ	Oregon Department of Environmental Quality
OR	Oregon
PA	Preliminary Assessment
RAC	Risk Assessment Code
RBC	Risk-Based Concentration(s)
RI	Remedial Investigation
Shaw	Shaw Environmental, Inc.
SHPO	State Historic Preservation Office
SI	Site Inspection
SROA	Sunriver Owners Association
SSWP	Site-Specific Work Plan
TAL	target analyte list
TPP	Technical Project Planning
USACE	U.S. Army Corps of Engineers
USEPA	U.S. Environmental Protection Agency
UXO	unexploded ordnance
Work Plan	*Type 1 Work Plan, Site Inspections at Multiple Sites*

Administrative Information

Site Inspection
Camp Abbot

Technical Project Planning Meeting
April 4, 2006

The Technical Project Planning (TPP) Memorandum is one in a series of documents used during the Site Inspection (SI) process to document the information collected and processes used to evaluate Formerly Used Defense Sites (FUDS) for the possible presence of munitions and explosives of concern (MEC) and/or munitions constituents (MC). TPP Meeting information provided in this Memorandum reflects both the original version of information shared with meeting participants, as well as changes/updates to site-specific information obtained during the TPP Meeting.

This TPP Memorandum addresses the SI for the former Camp Abbot, located at Sunriver, Oregon (OR). The TPP Meeting for the former Camp Abbot was conducted on April 4, 2006 at the Meeting Room, Sunriver Resort, Sunriver, OR. Representatives from the U.S. Army Corps of Engineers (USACE) – Omaha Design Center and Seattle District, Oregon Department of Environmental Quality (ODEQ), and Shaw Environmental, Inc. (Shaw) were in attendance. In addition, members of the Sunriver Owners Association (SROA) and a representative of the Sunriver Resort participated in the morning TPP discussion. A separate public meeting was held in the evening at the Great Hall meeting room, Sunriver Resort, Sunriver, OR. Thirteen community members attended the public meeting. A windshield site tour was conducted during the afternoon of April 4, 2006.

The TPP Memorandum documents discussions for the TPP meeting and includes the sections described below:

- **Administrative Information:** includes meeting logistics, the list of attendees, and a summary of the meeting;
- **Site Inspection Objectives:** provides the goal and objectives of the SI, roles and responsibilities, the SI process, and the TPP process;
- **Background Information:** includes site and project history, area physical setting, a summary of previous environmental work, and an introduction to the areas of concern (AOCs) addressed by the SI;
- **Conceptual Site Model (CSM):** used to identify environmental attributes, potential human and ecological receptors in the area's environment, and the relationships between these factors;
- **Proposed Sampling Scheme:** used to describe the type and quantity of samples to be taken, and the analytical methods to be used for characterizing the AOCs;
- **TPP Notes and Data Quality Objectives (DQOs):** used to capture project and site-specific information as discussed during the TPP Meeting to ensure the necessary and appropriate information is shared among meeting participants, and that meeting participants concur with the identified goal, objectives, and approach used to complete the SI process; and
- **Worksheets:** includes the **Site Information Worksheet,** Draft **Munitions Response Site Prioritization Protocol** (MRSPP) **Data Gaps, and Hazard Ranking System** (HRS) **Data Gaps.**

Meeting Location: Sunriver, Oregon
USACE District: Seattle
TPP #1 Meeting Date: 4/4/06

Agenda

Tuesday, April 4, 2006

- **Convene**
  - Location – Meeting Room, Sunriver Resort, Sunriver, OR 97707
  - Introductions
  - Review Site Inspection Objectives
    - Goals, Objectives, Roles & Responsibilities
    - Site Inspection Process
    - Technical Project Planning (TPP) Process
- **TPP Discussion**
- **Lunch Break**
- **Windshield Tour of Camp Abbot**
- **Summary/Concurrence**
- **Adjourn**
- **Convene Public Meeting in Evening**
  - Location – Meeting Room, Sunriver Resort, Sunriver, OR 97707
- **Adjourn Public Meeting**

Technical Project Planning Meeting
Minutes/Summary of Agreements

The TPP Meeting for former Camp Abbot was held at Sunriver Resort on April 4, 2006. In attendance were representatives of U.S. Army Corps of Engineers (USACE)-Omaha Design Center, USACE-Seattle District, Shaw Environmental, Oregon Department of Environmental Quality (ODEQ), Sunriver Owners Association (SROA), and Sunriver Resort. Attendance sheet is attached.

Shaw reviewed site information and presented a summary of the proposed approach for the SI, addressing MEC reconnaissance and MC sampling. ODEQ were in general agreement with the approach and the decision rules that were developed.

Specific discussion points included:

Analytical Methods: Team members indicated general agreement with proposed analytical methods. ODEQ agreed that it was appropriate to scale back analysis of metals from the full target analyte list (TAL) metals list.

Soil Sampling: Team members agreed that it was appropriate to use sampling and analytical data from the U.S. Environmental Protection Agency's (USEPA) PA/SI in cases where the specific objectives of this SI are met. ODEQ indicated that health-based screening values should use Risk-Based Concentrations (RBCs), per Oregon guidance on Risk-Based Decision Making Process for the Remediation of Petroleum-Contaminated Sites. For chemicals not addressed by the guidance, ODEQ USEPA Region 9 PRGs may be used.

Soil Background Sampling: Soil background will be established using 10 samples Visual Sampling Plan or similar software may be used to develop the background sampling approach. Methods to be used for the evaluation of background will be included in the Site-Specific Work Plan (SSWP).

Groundwater Sampling: It was agreed that additional groundwater sampling to assess MC impacts was necessary. Samples would be collected from existing wells.

Surface Water Sampling: It was agreed that a downstream flowing surface water sample and collocated sediment sample from the Deschutes River would be collected. EPA PA/SI collected an upstream sample which will serve as a background sample.

MEC Finds: Procedure for the handling and notifications of MEC finds during field activities will be detailed in SSWP.

Future Land Use: Future land use at Sunriver has been defined and is controlled largely through zoning and covenants. Only currently subdivided plots will be build on; other parcels owned by the resort and owners association will not be developed.

Grenade Court Reconnaissance Surveys: It was agreed to be all parties that reconnaissance surveys and potential sampling to the north of ASR Supplement identified practice courts would be included.

Site Inspection Objectives

Goal

- The USACE is conducting SIs of FUDS properties to determine if any MEC or related MC are present on property formerly owned or leased by the U.S. Department of Defense (DoD).

Objectives

- Determine if the site requires further response action due to the presence of MEC/MC.
- Collect minimum information needed to:
    - Eliminate a site from further consideration if:
        - No evidence of MEC and/or
        - Concentrations of MC in samples are below risk-based action levels, or below background concentrations; or
    - Determine the potential need for removal action or initiation of the Remedial Investigation/Feasibility Study (RI/FS) if:
        - MEC identified and/or
        - Concentrations of MC in samples exceed risk-based action levels and background concentrations.
    - Provide sufficient data for the USEPA and the Army to prioritize future actions using the HRS and MRSPP.

Roles & Responsibilities

- **USACE:** Acts as the executing agency for the DoD with regard to the FUDS program. In this role, the USACE has decision making authority and is responsible for ensuring work is conducted in accordance with applicable USACE and federal guidance. Additionally, USACE coordinates and works with project team members to meet needs expressed by regulatory agencies and stakeholders.
- **Regulatory Agency:** Participates in planning of SI activities in order to meet applicable requirements and stakeholders expectations.
- **Property Owner(s)**: Provides available and pertinent information about the area, identifies current and anticipated future land uses for the property, and participates in project team discussions.
- **Shaw**: As a contractor to the USACE, conducts work on behalf of the USACE, provides TPP materials, makes site information available to the project team through a web-based information portal, and conducts and reports SI activities.

Site Inspection Process

- Data review,
- TPP,
- SSWP,
- SI field activities – reconnaissance, sampling, and analysis, and
- SI Report.

Technical Project Planning Process

- Conduct TPP meeting(s)* with key organizations and stakeholders;
- Identify stakeholder(s) concerns;
- Identify all AOCs for this SI;
- Review site information;
- Verify current and anticipated future land use;
- Develop CSM;
- Identify data gaps;
- Plan how to address data gaps;
- Develop DQOs for meeting SI requirements; and
- Concur on SI field work approach.

* Second TPP meeting to be determined by team members during the 1st TPP meeting.

Background Information

Site Description and Regulatory History

Background and historical information (including references to interviews and historical documents) contained in this package were primarily obtained from the *Archives Search Report* (ASR) (USACE, 1995) and the *ASR Supplement* (USACE, 2004). Additional information was obtained from the following documents:

- Coll, B.D., J.E. Keith, and H.H. Rosenthal, 1958, *United States Army in World War II – The Corps of Engineers: Troops and Equipment*, Office of the Chief of Military History, United States Army.
- Lite Jr., K.E, and M.W. Gannett, 2002, *Geologic Framework of the Regional Ground-Water Flow System in the Upper Deschutes Basin, Oregon,* U.S. Geological Survey Water-Resources Investigations Report 02-4015.
- Sherrod, D.R., M.W. Gannett, K.E. Lite, Jr., 2002, *Hydrogeology of the Upper Deschutes Basin, Central Oregon: A Young Basin Adjacent to the Cascade Volcanic Arc,* in *Field Guide to Geologic Processes in Cascadia*: Oregon Department of Geology and Mineral Industries, Special Paper 26, pp. 109-144.
- Weston Solutions, Inc. (Weston), 2005, *Camp Abbot FUDS Preliminary Assessment/Site Inspection Report*, TDD 01-08-0006, USEPA Contract 68-S0-01-02, prepared for U.S. Environmental Protection Agency, April.
- Willingham, W.F., 1983, *Army Engineers and the Development of Oregon: A History of the Portland District U.S. Army Corps of Engineers*.

This document uses the spelling of "Camp Abbot," consistent with usage in most documents from the 1940's to the ASR in 1995. Other documents, including the ASR Supplement and current FUDS listings, as well as occasional older ones, refer to "Camp Abbott," or "Old Camp Abbott."

Site Location

- The former Camp Abbot is located in Deschutes County, Oregon, within and west of the community of Sunriver (Figure 1).
- The site is approximately 15 miles south of Bend, Oregon. It straddles the Deschutes River and Highway 97 is its eastern boundary
- Camp Abbot occupied 9,686.41 acres of land, principally acquired in October 1942.
- Camp Abbot has seven AOCs, including a small arms range complex, grenade courts, several ranges where explosive munitions were deployed (an anti-tank range, a mortar range, and a demolition area), a possible ordnance burial pit, and a chemical training area.

Physical Setting

- The landscape of the former camp varies from flat areas with low grass and few shrubs in the valley of the Deschutes River, to rugged hills, buttes, and cliffs with heavy shrubs and trees west of the river.

- East of the Deschutes River, much of the former Camp Abbot is now the resort and residential community of Sunriver. The privately owned area includes houses, condominiums, an airport, golf courses, bike paths, and a nature center.
- The portion of the former Camp Abbot west of the Deschutes River is under the control of the Forest Service and is virtually undeveloped.
- Current and expected future land use within the area of former Camp Abbot includes residential, recreational, and multiple Forest Service land uses.
- The community of Sunriver has a population of approximately 534 (U.S. Census Bureau estimate). The city of Bend, Oregon, 15 miles north of Camp Abbot, has a population of 62,937. Deschutes County has a total population of approximately 141,382.
- Camp Abbot is situated east of the Cascade Range, which strongly influences the area's climate. As air moves east over the Cascades, it descends and becomes drier. The annual average rainfall at Bend, Oregon is less than 12 inches, with average monthly precipitation ranging from a low of 0.49 inch in September to a high of 1.78 inches in December. The monthly average mean temperature ranges from 31.2 degrees Fahrenheit (ºF) in December and January to 63.5 ºF in July.

Previous Investigations and Regulatory History

- USACE prepared an inventory project report (INPR) for Camp Abbot in October 1993 and revised it in April 1994, identifying a potential hazard from ordnance at the FUDS.
- USACE issued an ASR in 1995, which compiled available information for Camp Abbot with emphasis on types and areas of ordnance use and disposal.
- An ASR Supplement, completed in 2004, identified specific AOCs.
- A Risk Assessment Code (RAC) scoring was conducted by USACE in 2004. Possible scores range from 5 (no risk) to 1 (high risk). The following table summarizes the RAC determinations for the AOCs and indications of whether MEC has been found at these AOCs since the end of Army training, as summarized in the ASR Supplement:

AOC	RAC Score	MEC Found
Burial Pit	1	No
Anti-Tank Range	1	Yes
Chemical Training Area	1	No
Demolition Area	1	No
Grenade Courts	1	No
Mortar Range	1	Yes
Range Complex No. 1	5	No

- A Preliminary Assessment/Site Inspection (PA/SI) was conducted by Weston (2004) for the USEPA. The scope of the PA/SI largely parallels the scope of this planned SI. To the extent possible, this SI will utilize data previously collected for the PA/SI. Additional

reconnaissance and sampling activity will be planned only to address specific data needs identified during the TPP. Some soil and sediment samples from Range Complex No. 1 and the Demolition Area contained metals at elevated concentrations with respect to background samples, as summarized in the following table. A surface water sample from the landfill area contained manganese at an elevated concentration of 84.5 micrograms per liter (µg/L).

Area	Sample No.	Arsenic milligrams per kilogram (mg/kg)	Lead (mg/kg)	Mercury (mg/kg)	Silver (mg/kg)
Potential Screening Value		*0.004*	*2*	*0.2*	*5*
Soil					
Background Soil	SS-BK001	0.91 UJK	2.9	.030 BJK	1.2 UJK
Range Complex No. 1	SS-MR001	--	--	0.96	--
	SS-MR003	1.5	24	--	--
	SS-RR001	3.1	--	--	--
	SS-RR002	5.2	--	--	--
	SS-RR003	3.2	--	--	6.1 JL
	SS-RR004	4.8	--	--	--
	SS-RR005	4.1	--	--	--
	SS-RR006	1.7	--	--	--
Demolition Area	SS-DP001	1.5	--	--	--
Sediment					
Background Sediment	SD-BK001	1.4 U	3.1 U	0.14 U	1.4 UJK
Range Complex No. 1	SD-MR001	--	2.9	--	--
	SD-RR001	--	2.2	--	--
	SD-RR002	--	3.3	--	--
	SD-DP001	--	2.9	--	--

Note: Only significant/elevated results are shown. See PA/SI (Weston, 2005) for explanation of data qualifiers.

Operational History and MEC/MC Characteristics

Historic Military Operations

- Camp Abbot was established as an Engineer Replacement Training Center (ERTC) during World War II. Construction of the camp was completed in May 1943, and it operated for approximately 14 months, until June 1944. In that time, a total of 90,000 engineer soldiers were trained (up to 10,000 men at a time).
- Camp trainees received instruction in military construction and engineering. General and specialist training programs, in periods ranging from 5 to 17 weeks, included instruction in heavy equipment operation, fire-fighting, carpentry, demolition, tank operation and maintenance, bridge construction, infiltration, mapmaking, pipeline construction, depot storage, specialized mechanics, aerial photography, water and sewage systems, camouflage, mine detection, and bomb disarmament.

- The 17-week general training program, a modification of earlier strategies involving shorter training periods and greater emphasis on specialist training, at the Army's three ERTCs went into effect in August 1943. The Camp Abbot program included three distinct phases:
    - Six weeks of basic military training, including rifle marksmanship, use of hand grenades and anti-tank grenades, and defense against chemical, air, and mechanized attack;
    - Eight weeks of technical training in demolitions, etc., preparing trainees for duty either as general engineers or as specialists;
    - A three-week, field maneuver spent under field and combat conditions, including such team training tasks as mine laying, demolitions, and building of bridges, roads, and obstacles.
- A letter dated 25 September 1946 states that Camp Abbot was "dedudded" in November 1944, and that "a recent inspection of Camp Abbot was made by the Chemical Officer of the 6th U. S. Army to determine whether poisonous gases were present on the area. The inspection showed that the "land was free of any such contamination."
- A War Department letter of 30 October 1946 stated that Camp Abbot "is hereby declared safe for return to private use."
- A letter dated 18 November 1947, relinquishing the Army's permits for use of Forest Service land, states "the lands have been examined and have been cleared of all explosives or explosive objects reasonably possible to detect by visual inspection."

MEC/MC Characteristics

- The MEC believed to have been used at the AOCs, related MC, and land use controls are delineated in Table 1.
- Documented reports of encounters with MEC or munitions debris since closure of Camp Abbot are summarized in Table 2. In some cases, a single encounter is referred to in more than one source and therefore appears in the table more than once. Locations of the encounters are not well defined at this time.

Groundwater

- The site is located along the Deschutes River in the High Lava Plains physiographic province of Oregon, a few miles east of the Cascade Range.
- The Cascade Range is a north-south trending zone of volcanic eruptive centers, including large stratovolcanoes North, Middle, and South Sister, and Mount Jefferson, which all exceed an elevation of 10,000 feet above sea level. Broad lava plateaus are interrupted by faults and fault-bounded grabens.
- The surficial geology of the site includes Pliocene, Pleistocene, and Holocene basaltic andesite and basalt flows that are often fractured and highly permeable (Figures 2 and 3). Deposits of alluvial and/or glacial outwash silt, sand, and gravel are present along the Deschutes River.

- Precipitation readily infiltrates the permeable lava flows, particularly in the Cascade Range where both precipitation and permeability are high.
- Groundwater flow is generally eastward from the Cascade Range into the Deschutes Basin, where fine-grained sedimentary and older volcanic units tend to divert groundwater flow to the surface, as evidenced by numerous springs feeding creeks and rivers.
- Available well records indicate that water wells are numerous in the community of Three Rivers directly south of the site (Figure 4). There are also water wells within the FUDS boundary in developed areas within and near Sunriver. Private domestic wells are typically less than a hundred feet deep, and the depth to groundwater is a few tens of feet.
- Soils at the site are generally very thin to absent, with surface outcrops of volcanic rocks.

Surface Water

- The site is located within the Upper Deschutes watershed and is drained in a generally northerly direction. The Deschutes River and two tributaries, the Little Deschutes River and Spring River, flow through the site.
- Several linear miles of wetland areas occur within and near the site.
- Upstream of Benham Falls (i.e., including the reach flowing through the site), the Deschutes River is a federally-designated Wild and Scenic River.
- Due to the rapid infiltration of precipitation into the groundwater system, much of the Upper Deschutes watershed lacks a well-developed stream system.
- Areas of groundwater discharge to surface water are indicated by springs located within the site along the west side of the Deschutes and Spring Rivers.
- The water department of the City of Bend uses surface water as its primary water source. All other water systems within Deschutes County use groundwater.

Terrestrial Exposure

- Residential areas are presently located within some of the AOCs.
- Numerous threatened or endangered species may occur on or near Camp Abbot, as identified by U.S. Fish and Wildlife Service and Oregon Department of Fish and Wildlife (USACE, 1995). The U.S. Fish and Wildlife Service will be contacted for an updated species list.
- The State Historical Preservation Office (SHPO) will be contacted to determine if historical or other cultural resources are present in the area.

Air

- The nearest populated areas are the communities of Sunriver, within the boundary of the former camp, and Three Rivers, south of the former camp.
- No previous air sampling was performed at the site.

Conceptual Site Model

Site Inspection
Camp Abbot

Technical Project Planning Meeting
April 4, 2006

Overview

A site-specific CSM summarizes available site information and identifies relationships between exposure pathways and associated receptors. A CSM is used to determine the data types necessary to describe site conditions and quantify receptor exposure, and discusses the following information:

- Current and future land use;
- Potential contaminant sources (i.e., lead projectiles in an impact berm);
- Affected media;
- Governing fate and transport processes (e.g., surface water runoff and/or groundwater migration);
- Exposure media (i.e., media through which receptors could contact site-related contamination);
- Routes of exposure (e.g., inhalation, incidental ingestion, and dermal contact); and
- Potential human and/or representative ecological receptors at the exposure point. Receptors likely to be exposed to site contaminants are identified based on current and expected future land uses.

The CSM is evaluated for completeness and further developed as needed through TPP meetings. The Camp Abbot AOCs are discussed in separate groupings based on similar historical use, and potential MEC and MC, as follows:

- Range Complex No. 1 (Small Arms Ranges), Figure 5);
- Explosive Munitions Ranges, including
    - Anti-Tank Range (Figure 6),
    - Demolition Area (Figure 7),
    - Mortar Range (Figure 8);
- Grenade Courts (Figure 9);
- Burial Pit (Figure 10);
- Chemical Training Area (Figure 11).

CSMs are presented for these AOC groups. MEC and MC are analyzed individually within each CSM.

Conceptual Site Model – Range Complex No. 1 (Small Arms Ranges)

The Range Complex No. 1 AOC includes the several sub-ranges where various small arms range activities took place. Some of these ranges were previously assessed during the USEPA's PA/SI (Weston, 2005). The range names used here are consistent with the ASR Supplement (2004); corresponding range names used in the PA/SI are provided in parentheses:

- Rifle Range (Northern Rifle Range)
- Rifle/Machine Gun Range (Southern Rifle Range)
- Landscape Range (Machine Gun Range)
- Transition Range
- Anti-Aircraft Range
- Field Target and Sub-Machine Gun Range

Current and Future Land Use

- Four of the ranges were located on the east side of the Deschutes River, with safety fans extending west of the river. These ranges are located in the area of the airport. Residential lots are adjacent to or slightly within the boundaries of some of these ranges.
- Two of the ranges were located west of the Deschutes River. The Anti-Aircraft Range includes some residential lots and Forest Service land; the Field Target and Sub-Machine Gun Range is wholly on Forest Service land.

Former Range Use

- The ranges were used by the Army between 1943 and 1944.
- Weapons used at these ranges were limited to general small arms.
- At some ranges, firing would have taken place from fixed positions or within a restricted area up to a fixed limit of advance. Small arms fire may have been directed toward targets in front of man-made backstop berms (Figure 12).
- At the Anti-Aircraft Range and the Field Target and Sub-Machine Gun Range, small arms fire would tend to be dispersed over a wider area due to the variety of target positions and/or firing positions.
- General small arms (up to .50-caliber) may have been used at these ranges. However, although ERTCs were issued the .50 caliber machine gun, the use of this weapon was limited due to a limited supply of ammunition, and much machine gun training used the .30 caliber weapon (Coll, 1958, p. 264).

MEC Evaluation

Types of MEC

- The munitions used at these AOCs were limited to small arms rounds, which do not pose a significant explosive hazard.

- The potential for unexploded ordnance (UXO) to be present at these locations is low, although the potential exists that some unknown activities involving explosive MEC may have taken place at these locations.
- Greater potential for explosive MEC is present in portions of these ranges that overlap other types of ranges (i.e., the Anti-Tank Range and Grenade Courts).

Surface Exposure Pathway

- Slight MEC risk is associated with potential for unknown use of explosive MEC at the infantry ranges.

Subsurface Exposure Pathway

- Slight MEC risk is associated with potential for unknown use of explosive MEC at the infantry ranges.

An analysis of the exposure pathways and receptors for MEC is provided in Table 3.

MEC Evaluation/Investigation Needed

- Visual reconnaissance of selected portions of the AOC will be conducted by a qualified UXO technician with the aid of a hand-held magnetometer, with the objectives of assessing the presence or absence of MEC and determining appropriate MC sample locations.

MC Evaluation

Types of MC

- The anticipated MC at the small arms ranges is lead from the munitions debris.
- A relatively small quantity of copper and antimony is present in military bullets. Because lead accounts for more than 96 percent of the bullet mass, analysis for lead alone will be adequate as an indicator of MC contamination.
- A significant perchlorate source has not been identified with these AOCs. Although .50 caliber weapons may have been used at some of these ranges, the potential period of use was short (14 months) and the available supply of ammunition at the ERTCs is known to have been limited.

Overview of Pathways

Affected media and potential pathways for MC include:

- Soil: Soil is the primary medium of concern because of possible MC in the soil from training activities. The soil also serves as a source of potential air, surface water, or groundwater contamination.
- Surface Water/Sediment: Surface water may act as a migration pathway from potential sources of contamination in soil. Accumulation of lead may occur in sediment along surface water migration pathways. Sediment will be the primary sample medium to assess surface water pathways.

- Groundwater: Groundwater is considered a potentially affected media because it is likely to be present at shallow depths beneath the ground surface. However, the presence of springs in this area indicates that groundwater is discharging to the surface water pathway.
- Air: Inhalation of MC in vapor form is not a pathway of concern for non-volatile MC under normal environmental conditions. Potential inhalation of soil particles is included in the development of health-based screening values for soil.

Potential exposure media include soil, surface water/sediment, and groundwater. A pathway evaluation for these media is discussed below and provided in Table 3.

Soil Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated soils include incidental ingestion of and dermal contact with contaminated media, as well as inhalation of soil particulates during intrusive work.
- The potential exposure routes of pets, livestock, and wildlife to contaminated soils include ingestion of and direct contact with contaminated media. Plants may uptake MC and then subsequently be eaten by livestock and wildlife. Burrowing animals may ingest MC-contaminated soil and subsequently be eaten by predators.

Receptors

- Residents.
- Workers (farmers, foresters, etc).
- Recreational users.
- Pets, livestock, and wildlife.

Soil MC Evaluation/Investigation Needed

- Nine soil samples were collected from this AOC for the USEPA's PA/SI investigation (Weston, 2005).
- Two soil samples are proposed at the Anti-Aircraft Range.
- Two soil samples are proposed at the Field Target and Sub-Machine Gun Range.
- Samples to be analyzed for lead.

Surface Water/Sediment Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated surface water and sediment include ingestion, dermal contact, and inhalation.
- The potential routes of pets, livestock, and wildlife (including aquatic organisms) exposure to contaminated surface water include ingestion and direct contact.

Receptors

- Residents.
- Workers (Farmers, foresters, etc).
- Recreational users.
- Pets, livestock, and wildlife.

Surface Water/Sediment MC Evaluation/Investigation Needed

- Three sediment samples were collected from this AOC for the USEPA's PA/SI investigation (Weston, 2005).
- One sediment sample is proposed at the Anti-Aircraft Range.
- One sediment sample is proposed at the Field Target and Sub-Machine Gun Range.
- Samples to be analyzed for lead.

Groundwater Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated groundwater include ingestion, dermal contact, and inhalation where groundwater is used as a water supply. Numerous domestic water wells are located within and near the southern portion of the Range Complex No. 1 AOC (Figure 4).
- Direct exposure of wildlife to groundwater is not a concern.

Receptors

- Residents.
- Workers (farmers, foresters, etc).
- Recreational users.
- Pets or livestock.

Groundwater MC Evaluation/Investigation Needed

- The PA/SI (Weston, 2005) addressed the groundwater pathway for the Camp Abbot FUDS with one groundwater sample from a well in Sunriver, approximately 0.75 mile east of Range Complex No. 1. The sample was analyzed for explosives and perchlorate, which were not detected.
- The PA/SI also cited analytical data from the same well. The following metals were included in the analyses: antimony, arsenic, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, sodium, and thallium. Only sodium was detected at a concentration of 9.65 milligrams per liter (mg/L).

Conceptual Site Model – Explosive Munitions Ranges

The explosive munitions range AOCs include three ranges where various munitions activities took place. One of these ranges (Demolition Area) was previously assessed during the USEPA's PA/SI (Weston, 2005). The range names used here are consistent with the ASR Supplement (2004); the corresponding range name used in the PA/SI is provided in parentheses:

The explosive munitions range AOCs at Camp Abbot include:

- Anti-Tank Range
- Demolition Area (Demolition Pits)
- Mortar Range

Current and Future Land Use

- The Anti-Tank range is located on Forest Service land (mostly west of the Deschutes River) and land associated with the Sunriver Resort (between the airport landing strip and the river). A few residential lots extend into the extreme southern limit of the range's safety fan.
- The Demolition Area is located wholly on Forest Service land.
- The estimated area of the Mortar Range (per the ASR Supplement) encompasses an impact area (based on MEC encounters) on Forest Service land west of the Deschutes River. An estimated firing position is shown in an area of private residential properties within Sunriver, east of the river.

Former Range Use

- The ranges were used by the Army between 1943 and 1944.
- The period of use for the Demolition Area may have been more limited. Three-week team training exercises were not begun at Camp Abbot until December 2003 (Coll and others, 1958, pp. 265-266). A Camp Abbot newspaper article dated 12 February 1944 refers to a "new assault and demolitions course."
- The article states that the new course "incorporates many problems of actual warfare, including barbed wire entanglements and machine gun fire." Steps in the course included:
    - Use of a tank, directing simulated fire (using set charges to give the appearance of shells fired from the tank's guns) at enemy machine gun nests and pill boxes,
    - A demolitions squad using Bangalore torpedoes to clear barbed wire entanglements,
    - A flame-thrower crew "running the distance and taking full advantage of cover and shell holes, to burn what remains of the 'enemy' from its positions," and
    - The demolitions squad "setting charges which complete destruction of the fortifications."

- The ASR Supplement provided an estimated boundary of the Mortar Range, based on reported finds of 60 millimeter (mm) and 81 mm mortars, assuming firing directed to the west from a position east of the river shown as a "tactical area" on historic maps. It is considered probable that mortar fire may have been directed to the north from a position west of the river, particularly if firing was conducted as part of the assault and demolitions training described above.
- A generalized, visual representation of the CSM for explosive munitions ranges is presented in Figure 13.

MEC Evaluation

Types of MEC

- Specific munitions for the explosives munitions range AOCs are presented in Table 1. Some munitions were in short supply at the ERTCs, including anti-tank rockets (the allowance for was one rocket for every 50 men) and flame throwers (Coll, 1958, p. 264).
- In addition to the munitions listed in Table 1, the ASR identified the use of heavy artillery, assumed to include 57 mm, 75 mm, and/or 76 mm rounds. The potential for artillery rounds is supported by a reported find at an unknown location west of Sunriver and the Deschutes River (Table 2).
- A 2.36-inch rocket was reportedly found in the area of the Anti-Tank Range (Table 2, and ASR Supplement).
- Mortar rounds, both 60 mm and 81 mm, were reportedly found in the area of the Mortar Range (Table 2).
- Other reports of MEC encounters may be associated with one or more of these ranges, but specific locations are not known.
- There is a potential hazard from MEC, as indicated by reported encounters of explosive MEC as recently as 1988.

Surface Exposure Pathway

- The potential route of human exposure to MEC or munitions debris includes direct contact by vehicles, foot traffic, or handling. Human exposure would potentially include residents, workers, and recreational users.
- The potential route of livestock and wildlife exposure to MEC or munitions debris would be by direct contact.

Subsurface Exposure Pathway

- The potential routes of human exposure to MEC or munitions debris would be through intrusive activity, environmental processes (erosion, freeze-thaw, etc.), or geologic instability.
- The potential route of livestock and wildlife exposure to MEC or munitions debris would be by burrowing activities or geologic instability.

An analysis of the exposure pathways and receptors for MEC is provided in Table 3.

MEC Evaluation/Investigation Needed

- At the Anti-Tank Range and the Mortar Range, where the presence of MEC is established based on previous finds, visual reconnaissance of selected portions of the AOC will be conducted by a qualified UXO technician with the aid of a hand-held magnetometer, with the objective of identifying appropriate sample locations. MEC, munitions debris, or other evidence of range activity, if found, will be used to select sample locations, but the survey is not intended to establish the presence or absence of MEC.

- At the Demolition Area, visual reconnaissance previously was conducted by a UXO technician and no MEC was observed (Weston, 2005). Further reconnaissance of the area is not proposed. However, MEC is considered to be potentially present because the Mortar Range, where MEC has been found, potentially overlaps this AOC.

MC Evaluation

Types of MC

- The anticipated MC at the explosive munitions ranges is primarily residual explosive compounds from munitions that underwent low-order detonation or from undetonated munitions.
- There is a potential for the presence of elevated concentrations of metals. Sources primarily would include the metallic content of the projectiles and other munitions components. Small quantities of metals were also used in tracers, incendiary mixtures, and in primary explosives.
- A significant perchlorate source has not been identified with these AOCs. Although .50 caliber weapons may have been used at some of these ranges, the potential period of use was short (14 months) and the available supply of ammunition at the ERTCs is known to have been limited.

Overview of Pathways

Affected media and potential pathways for MC include:

- Soil: Soil is the primary medium of concern because of possible MC in the soil from training activities. The soil also serves as a source of potential air, surface water, or groundwater contamination.
- Surface Water/Sediment: Surface water may act as a migration pathway from potential sources of contamination in soil. Accumulation of lead and explosives may occur in sediment along surface water migration pathways. Sediment will be the primary sample medium to assess surface water pathways.
- Groundwater: Groundwater is considered a potentially affected media because it is likely to be present at shallow depths beneath the ground surface. However, the presence of springs in this area indicates that groundwater is discharging to the surface water pathway.
- Air: Inhalation of MC in vapor form is not a pathway of concern for non-volatile MC under normal environmental conditions. Potential inhalation of soil particles is included in the development of health-based screening values for soil.

Potential exposure media include soil, surface water/sediment, and groundwater. A pathway evaluation for these media is discussed below and provided in Table 3.

Soil Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated soils include incidental ingestion of and dermal contact with contaminated media, as well as inhalation of soil particulates during intrusive work.
- The potential routes of livestock and wildlife exposure to contaminated soils include ingestion of and direct contact with contaminated media. Plants may uptake MC and then subsequently be eaten by livestock and wildlife. Burrowing animals may ingest MC-contaminated soil and subsequently be eaten by predators.

Receptors

- Residents.
- Workers (farmers, foresters, etc).
- Recreational users.
- Livestock and wildlife.

Soil MC Evaluation/Investigation Needed

- Anti-Tank Range: One soil sample is proposed in the range target area.
- Demolition Area: Three soil samples were collected from this AOC for the US EPA's PA/SI investigation (Weston, 2005).
- Mortar Range: Two soil samples are proposed in the impact area (where MEC finds were reported).
- Proposed samples will be analyzed for explosives and select metals based on munitions used.

Surface Water/Sediment Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated surface water and sediment include ingestion, dermal contact, and inhalation of water.
- The potential routes of livestock and wildlife (including aquatic organisms) exposure to contaminated surface water include ingestion and direct contact.

Receptors

- Residents.
- Workers (farmers, foresters, etc).
- Recreational users.
- Livestock and wildlife.

Surface Water/Sediment MC Evaluation/Investigation Needed

- Anti-Tank Range: One sediment sample collected for the USEPA's PA/SI investigation (Weston, 2005), in association with Range Complex No. 1, appears to represent the surface water/sediment pathway from this AOC.
- Demolition Area: One sediment sample was collected for this AOC in the USEPA's PA/SI investigation (Weston, 2005).
- Mortar Range: The sediment sample noted above, collected for the USEPA's PA/SI investigation (Weston, 2005), in association with the Demolition Area, appears to represent the surface water/sediment pathway from this AOC.

Groundwater Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated groundwater include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.
- Numerous domestic water wells are located south of the Anti-Tank Range (Figure 4).
- No wells are located in the vicinity of the Demolition Area or the impact area of the Mortar Range, and discharge of groundwater to springs along the Deschutes River suggests a hydrologic barrier between these areas and wells to the east in Sunriver.
- Direct exposure of wildlife to groundwater is not a concern.

Receptors

- Residents.
- Workers (farmers, foresters, etc).
- Recreational users.
- Pets or livestock.

Groundwater MC Evaluation/Investigation Needed

- The PA/SI (Weston, 2005) addressed the groundwater pathway for the Camp Abbot FUDS with one groundwater sample from a well in Sunriver. The sample was analyzed for explosives and perchlorate, which were not detected.

- The PA/SI also cited analytical data from the same well. The following metals were included in the analyses: antimony, arsenic, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, sodium, and thallium. Only sodium was detected at a concentration of 9.65 mg/L.

Conceptual Site Model – Grenade Courts

- The Grenade Courts AOC was previously assessed during the EPA's PA/SI (Weston, 2005) and was identified in that report as the Grenade Court.
- The ASR (Appendix D) identified a Live Grenade Area located north of the Grenade Court identified in the ASR Supplement.

Current and Future Land Use

- The AOC is located on Forest Service land.
- The AOC is adjacent to a residential area and the Deschutes River, and thus may receive considerable recreational use.

Former Range Use

- The Grenade Courts were used by the Army between 1943 and 1944.
- The courts were used for training in the use of live (explosive) and/or training hand grenades.
- Grenades were thrown from individual throwing bays constructed from sandbags or concrete, or from a trench.
- Grenades were thrown toward targets in an impact area approximately 25 yards from the throwing line (Figure 14).
- A safety zone of approximately 600 feet would have been established around the court.
- No specific information is available for the Live Grenade Area.

MEC Evaluation

Types of MEC

- The munitions used likely included the Mk II fragmentation hand grenade.
- M21 Practice grenades, which contained only small spotting charges of black powder, also may have been used.
- Other types of grenades, including smoke and incendiary grenades, may have been used, although quantities would have been limited due to the short duration use and the amount of time trainees spent in non-military training.
- Although no MEC has been reported in the area of the former grenade courts, some potential for the presence of MEC exists.

Surface Exposure Pathway

- The potential route of human exposure to MEC or munitions debris includes direct contact by vehicles, foot traffic, or handling. Human exposure would potentially include residents, workers, and recreational users.
- The potential route of livestock and wildlife exposure to MEC or munitions debris would be by direct contact.

Subsurface Exposure Pathway

- The potential routes of human exposure to MEC or munitions debris would be through intrusive activity, environmental processes (erosion, freeze-thaw, etc.), or geologic instability.
- The potential route of livestock and wildlife exposure to MEC or munitions debris would be by burrowing activities or geologic instability.

An analysis of the exposure pathways and receptors for MEC are provided in Table 3.

MEC Evaluation/Investigation Needed

- At the Grenade Courts, visual reconnaissance was previously conducted by a UXO technician and no MEC was observed (Weston, 2005). The survey area, however, appears to be more limited than the AOC as defined in this TPP Memorandum.
- The area of reconnaissance will be expanded throughout the AOC and extended north to the junction of Deschutes and Spring Rivers, where one historical map (ASR, Appendix D) indicates live hand grenade training may have occurred. Visual reconnaissance will be conducted by a qualified UXO technician with the aid of a hand-held magnetometer, with the objectives of assessing the presence or absence of MEC and determining appropriate MC sample locations.

MC Evaluation

Types of MC

- The anticipated MC at the Grenade Courts is primarily residual explosive compounds from grenades that underwent high-order (normal) or low-order detonation, or from undetonated munitions. The explosive charges used in the Mk II grenades were 2 ounces of trinitrotoluene (or E.C. blank smokeless powder, consisting largely of nitrocellulose, in older models).
- There is a potential for the presence of elevated concentrations of metals from the grenade housing and components.
- The potential for other MC related to the possible limited use of smoke and incendiary grenades is considered to be very low and will not be addressed further.

Overview of Pathways

Affected media and potential pathways for MC include:

- Soil: Soil is the primary medium of concern because of possible MC in the soil from training activities. The soil also serves as a source of potential air, surface water, or groundwater contamination.
- Surface Water/Sediment: Surface water may act as a migration pathway from potential sources of contamination in soil. Accumulation of explosives and metals may occur in sediment along surface water migration pathways.
- Groundwater: Groundwater is considered a potentially affected media because it is likely to be present within a few feet of the surface. Groundwater is likely to be discharging to

surface water along the nearby rivers, but the possibility of a groundwater pathway to receptors remains due to the presence of nearby domestic water wells.

- Air: Inhalation of MC in vapor form is not a pathway of concern for non-volatile MC under normal environmental conditions. Potential inhalation of soil particles is included in the development of health-based screening values for soil.

Potential exposure media include soil, surface water/sediment, and groundwater. A pathway evaluation for these media is discussed below and provided in Table 3.

Soil Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated soils include incidental ingestion of and dermal contact with contaminated media, as well as inhalation of soil particulates during intrusive work.
- The potential routes of livestock and wildlife exposure to contaminated soils include ingestion of and direct contact with contaminated media. Plants may uptake MC and then subsequently be eaten by livestock and wildlife. Burrowing animals may ingest MC-contaminated soil and subsequently be eaten by predators.

Receptors

- Residents.
- Workers
- Recreational users.
- Livestock, pets, and wildlife.

Soil MC Evaluation/Investigation Needed

- Three soil samples were collected from this AOC for the USEPA's PA/SI investigation (Weston, 2005).
- If reconnaissance identifies an area with evidence of munitions activity beyond the area evaluated during the PA/SI, at least one additional soil sample will be collected.
- Potential samples will be analyzed for explosives and select metals based on munitions used.

Surface Water/Sediment Exposure Pathway

Exposure Routes

- The relatively proximity of this AOC to rivers suggest a potential surface water pathway.
- The potential routes of human exposure to contaminated surface water and sediment include ingestion, dermal contact, and inhalation.
- The potential routes of livestock and wildlife (including aquatic organisms) exposure to contaminated surface water include ingestion and direct contact.

Receptors

- Residents.
- Workers (farmers, foresters, etc).
- Recreational users.
- Livestock, pets, and wildlife.

Surface Water/Sediment MC Evaluation/Investigation Needed

- One sediment sample was collected from this AOC for the USEPA's PA/SI investigation (Weston, 2005).
- If reconnaissance identifies an area with evidence of munitions activity beyond the area evaluated during the PA/SI, an additional sediment sample may be collected if a separate probable point of entry to the river is identified.
- The potential sample will be analyzed for explosives and select metals based on munitions used.

Groundwater Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated groundwater include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.
- Direct exposure of wildlife to groundwater is not a concern. The potential routes of livestock exposure include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.

Receptors

- Residents.
- Workers (farmers, foresters, etc).
- Recreational users.
- Livestock and pets.

Groundwater MC Evaluation/Investigation Needed

- The PA/SI (Weston, 2005) addressed the groundwater pathway for the Camp Abbot FUDS with one groundwater sample from a well in Sunriver. The sample was analyzed for explosives and perchlorate, which were not detected.

- The PA/SI also cited analytical data from the same well. The following metals were included in the analyses: antimony, arsenic, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, sodium, and thallium. Only sodium was detected at a concentration of 9.65 mg/L.

Conceptual Site Model – Burial Pit

- The vicinity of Burial Pit AOC was previously assessed during the USEPA's PA/SI (Weston, 2005), which identified the area of its activity as the landfill. However, it is not clear at this time if the PA/SI samples coincide with the specific burial pit feature that is the focus or this assessment.

Current and Future Land Use

- The AOC is located centered at the Sunriver Nature Center, where recreational and educational use would occur.
- Nearby properties (within the AOC boundary as currently configured) are owned by other Sunriver entities and appear to include open space and the northern portion of the airport landing strip.
- Residential properties are located within or near the eastern boundary of the AOC.
- The Deschutes River flows past the northwest corner of the AOC, suggesting an additional source of recreational access to the area.

Former Range Use

- The landfill was used by the Army between 1943 and 1944.
- Air photo review conducted for the ASR found evidence that the landfill had expanded eastward between 1951 and 1968, indicating continued use of the landfill by others following closure of Camp Abbot.
- A site inspection conducted for the ASR in 1995 identified a horseshoe-shaped area, bermed and ringed with stone, as a potential ordnance disposal pit.
- If the pit was used for ordnance disposal, any munitions used at Camp Abbot (as identified in the ASR Supplement and summarized in Table 1) potentially may have been placed in the pit.
- The ASR states that "local inhabitants indicate that both OE *(ordnance and explosives)* and CWM *(chemical warfare materiel)* contamination may be buried in the old landfill," although there is no indication of the basis of this idea.
- There is evidence that chemical agents were used on a limited basis at Camp Abbot and therefore may have been disposed in the pit. A camp newspaper article (ASR, Appendix G-3) refers to a training program that included identity of agents, and refers to actual use of mustard and vesicant gases (indicating likely use of gas identification sets).
- The training program described above was a 34-hour specialist course taught for 30 officers and noncommissioned officers. There is no indication that chemical training of this type was part of the general program for enlisted personnel, and the quantity of chemical agents used at Camp Abbot was likely very small.

MEC Evaluation

Types of MEC

- Any munitions used at Camp Abbot may have been placed in the burial pit (see Table 1).
- Although no MEC has been reported in the area of the landfill, some potential for the presence of MEC in exists, primarily in the subsurface.

Surface Exposure Pathway

- The potential route of human exposure to MEC or munitions debris includes direct contact by vehicles, foot traffic, or handling. Human exposure would potentially include residents, workers, and recreational users.
- The potential route of livestock and wildlife exposure to MEC or munitions debris would be by direct contact.

Subsurface Exposure Pathway

- The potential routes of human exposure to MEC or munitions debris would be through intrusive activity, environmental processes (erosion, freeze-thaw, etc.), or geologic instability.
- The potential route of livestock and wildlife exposure to MEC or munitions debris would be by burrowing activities or geologic instability.

An analysis of the exposure pathways and receptors for MEC are provided in Table 3.

MEC Evaluation/Investigation Needed

- Visual reconnaissance of the AOC will be conducted to determine the location of the horseshoe-shaped area, bermed and ringed with stone, i.e., the potential disposal pit. This location will be surveyed by a qualified UXO technician with the aid of a hand-held magnetometer, with the objectives of assessing the presence or absence of MEC and determining appropriate MC sample locations.

MC Evaluation

Types of MC

- The anticipated MC at the Burial Pit potentially includes explosives from undetonated munitions and metals from munitions components.
- Any of the small quantity of chemical agents that may have been released in this area would not be expected to have persisted and/or have been released in quantities that would pose a significant risk of environmental contamination.
- The potential for other MC related to the possible limited use of smoke and incendiary grenades is considered to be very low and will not be addressed further.

Overview of Pathways

Affected media and potential pathways for MC include:

- Soil: Soil is the primary medium of concern because of possible MC in the soil from training activities. The soil also serves as a source of potential air, surface water, or groundwater contamination.
- Surface Water/Sediment: Surface water may act as a migration pathway from potential sources of contamination in soil. Accumulation of explosives and metals may occur in sediment along surface water migration pathways.
- Groundwater: Groundwater is considered a potentially affected media because it is likely to be present within a few feet of the surface. Groundwater is likely to be discharging to surface water along the nearby river, but the possibility of a groundwater pathway to receptors remains due to the presence of nearby water wells, including one or more wells.
- Air: Inhalation of MC in vapor form is not a pathway of concern for non-volatile MC under normal environmental conditions. Potential inhalation of soil particles is included in the development of health-based screening values for soil.

Potential exposure media include soil, surface water/sediment, and groundwater. A pathway evaluation for these media is discussed below and provided in Table 3.

Soil Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated soils include incidental ingestion of and dermal contact with contaminated media, as well as inhalation of soil particulates during intrusive work.
- The potential routes of livestock and wildlife exposure to contaminated soils include ingestion of and direct contact with contaminated media. Plants may uptake MC and then subsequently be eaten by livestock and wildlife. Burrowing animals may ingest MC-contaminated soil and subsequently be eaten by predators.

Receptors

- Residents.
- Workers
- Recreational users.
- Pets and wildlife.

Soil MC Evaluation/Investigation Needed

- Two soil samples (one surface and one subsurface sample) were collected from this AOC for the USEPA's PA/SI investigation (Weston, 2005).
- If reconnaissance determines that the horseshoe-shaped area, bermed and ringed with stone (the potential disposal pit) is beyond the area evaluated during the PA/SI, at least two additional soil samples (one surface and one subsurface sample) will be collected.
- Potential samples will be analyzed for explosives and select metals based on munitions used or disposed.

Surface Water/Sediment Exposure Pathway

Exposure Routes

- The relatively proximity of this AOC to rivers suggest a potential surface water pathway.
- The potential routes of human exposure to contaminated surface water and sediment include ingestion, dermal contact, and inhalation.
- The potential routes of livestock and wildlife (including aquatic organisms) exposure to contaminated surface water include ingestion and direct contact.

Receptors

- Residents.
- Workers (including nature center employees).
- Recreational users.
- Pets and wildlife.

Surface Water/Sediment MC Evaluation/Investigation Needed

- One sediment sample was collected from this AOC for the USEPA's PA/SI investigation (Weston, 2005).
- If reconnaissance determines that the horseshoe-shaped area, bermed and ringed with stone (the potential disposal pit) is beyond the area evaluated during the PA/SI, an additional sediment sample may be collected if a separate probable point of entry to the river is identified.
- The potential sample will be analyzed for explosives and select metals based on munitions used or disposed.

Groundwater Exposure Pathway

Exposure Routes

- The potential routes of human exposure to contaminated groundwater include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.
- Direct exposure of wildlife to groundwater is not a concern. The potential routes of livestock exposure include ingestion, dermal contact, and inhalation where groundwater is used as a water supply.

Receptors

- Residents.
- Workers (including nature center employees).
- Recreational users.
- Pets.

Groundwater MC Evaluation/Investigation Needed

- The PA/SI (Weston, 2005) addressed the groundwater pathway for the Camp Abbot FUDS with one groundwater sample from a well in Sunriver. The sample was analyzed for explosives and perchlorate, which were not detected.

- The PA/SI also cited analytical data from the same well. The following metals were included in the analyses: antimony, arsenic, barium, beryllium, cadmium, chromium, lead, mercury, nickel, selenium, sodium, and thallium. Only sodium was detected at a concentration of 9.65 mg/L.

Conceptual Site Model – Chemical Training Area

Current and Future Land Use

- This AOC is located on privately owned land in an area of private residential lots within Sunriver.

Former Range Use

- The area was used by the Army between 1943 and 1944.
- Historical maps indicate a gas chamber was located here, where soldiers were trained in the proper use of gas masks (Photograph 1).
- There is evidence that chemical agents were used on a limited basis at Camp Abbot. A camp newspaper article (ASR, Appendix G-3) refers to a training program that included "repair of gas masks, protective measures against all types of chemical warfare agents, offensive use of gas, first aid measures, knowledge and identity of gasses, fighting incendiaries, handling violent mobs with gas, and night reconnaissance of gassed areas."
- Due to the location of this area, adjacent to the cantonment area and in close proximity to the base hospital (Figure 11), it is highly unlikely that any conventional weapons or chemical agents were used here, with the possible exception of chemical identification "sniff" sets, which contained several 4-ounce glass bottles variously containing 50 cubic centimeters of charcoal saturated with agent gas or small quantities of solid agents, and intended for indoor use (Photograph 2).
- The specific training program described above was a 34-hour specialist course taught for 30 officers and noncommissioned officers. There is no indication that chemical training of this type was part of the general program for enlisted personnel, and the quantity of chemical agents used at Camp Abbot was likely very small.

MEC Evaluation

Types of MEC

- Based on the location of this AOC relative to the cantonment and the types of activities that may have occurred here, neither conventional explosive MEC nor chemical agents are expected to be present at this AOC.

MEC Evaluation/Investigation Needed

- Investigation for MEC at this location is not needed.

MC Evaluation

Types of MC

- Any chemical agents that may have been released in this area, e.g., small quantities of gas associated with use of identification "sniff" sets, would not be expected to persist, and therefore, would not pose a significant risk of environmental contamination.

MC Evaluation/Investigation Needed

- No field investigation is needed.

Data Gaps

- The presence of MEC at Camp Abbot is established by past encounters, which have occurred as recently as 1988.
- Range Complex No. 1 (small arms ranges):
    - MEC has not been reported, but may be present based on overlapping area with the Anti-Tank Range or other unknown activity.
    - The presence of MEC is unknown (beyond the boundary of the Anti-Tank Range) and limited reconnaissance may support an SI finding of whether MEC is present or absent at this AOC.
    - Two subranges (Anti-Aircraft Range and field Target and Machine-Gun Range) were not addressed in the USEPA's PA/SI and sampling is proposed to address soil contamination and surface water/sediment pathways.
- Anti-Tank Range: Sampling is proposed to address soil contamination and surface water/sediment pathways.
- Mortar Range:
    - Sampling is proposed to address soil contamination and surface water/sediment pathways.
- Grenade Courts:
    - Reconnaissance is proposed to assess the possible presence of a grenade court north of the area addressed in the USEPA's PA/SI.
    - If evidence of munitions activity is found in the expanded inspection area, sampling is proposed to address soil contamination and surface water/sediment pathways.
- Burial Pit:
    - Reconnaissance is proposed to find the specific location of the horseshoe-shaped area, bermed and ringed with stone (the potential ordnance disposal pit) and to determine whether MEC is potentially present.
    - If the potential ordnance disposal pit is not located where samples from the USEPA's PA/SI were collected, sampling is proposed to address soil contamination and surface water/sediment pathways.
- Sampling is proposed to establish a statistically-valid background soil concentration for metals. Sampling will consist of the collection of 10 soil samples from areas not impacted by Camp Abbot activities. The SSWP will identify sampling locations and background evaluation methodology.
- USEPA's PA/SI addressed the potential impact to groundwater at the Camp Abbot FUDS with one groundwater sample from a well in Sunriver. Two additional groundwater samples will be collected from existing wells to assess Camp Abbot impacts to groundwater.

Results of the current status of data requirements with respect to MEC and MC for the AOCs located at the former Camp Abbot are summarized below:

AOC	Presence or Absence of MEC	Presence or Absence of MC	Proposed Inspection Activities
Range Complex No. 1	Unknown	Metals Present (Background assessment needed)	Reconnaissance for MEC & sample location. Soil & sediment sampling.
Anti-Tank Range	Present	Unknown	Reconnaissance for sample location. Soil sampling.
Demolition Area	Present (range overlap)	Metals Present (Background assessment needed)	None.
Mortar Range	Present	Unknown	Reconnaissance for sample location. Soil sampling.
Grenade Courts	Unknown	Unknown	Reconnaissance for MEC & sample location. Potential soil & sediment sampling.
Burial Pit	Unknown	Metals Present (Landfill--Background assessment needed))	Reconnaissance for MEC & sample location. Potential soil & sediment sampling.
Chemical Training Area	Absent (historical)	Absent (historical)	None.
Soil Background	Not Applicable	Not Applicable	Collect 10 soil samples.
Groundwater	Not Applicable	Unknown	Collect 2 groundwater samples.

Proposed Sampling Scheme

Proposed Field Investigation

The proposed field investigation to be conducted at the former Camp Abbot is detailed below. The investigation approach will be defined in more detail in a SSWP that will be submitted to ODEQ and other stakeholders for review. The SSWP will reference technical details including sampling and analytical methods that are described in the *Type I Work Plan, Site Inspections at Multiple Sites* (Work Plan), prepared by Shaw and submitted to USACE as final in February 2006. The following methodologies generally will apply.

Reconnaissance

A visual reconnaissance of selected portions of each AOC will be performed prior to any sampling. The inspection will be conducted by a qualified UXO technician, with the aid of a hand-held magnetometer, to assure that personnel avoid any potential MEC at all times and to select optimal sample locations within the area. Special attention will be given to physical features such as berms or hillsides that may have served as range backstops or impact areas, as well as indications of munitions debris or other objects such as targets that could indicate the potential presence of MC. A global positioning system (GPS) will be used to record discovered MEC, munitions debris, and sample point locations. Digital photographs will be taken to document significant features. At AOCs where reconnaissance objectives are limited to MEC avoidance and sample selection, specific reconnaissance transects will not be recorded.

At some AOCs, the reconnaissance will have an additional objective of assessing the presence or absence of MEC within a portion of the AOC. Several transects will be walked through targeted areas during which visual observations and magnetic anomalies will be noted. Transects will be recorded using GPS, and appropriate features influencing the survey will be noted, such as vegetation density and type, topography, etc. If MEC is found, the qualified UXO technician will attempt to make a determination of the hazard, and appropriate notifications will be made as detailed in the Work Plan and SSWP.

Sampling

Surface soil samples will be collected at a depth of approximately 0 to 2 inches below ground surface. Surface soil samples will be composite samples (7-point, wheel pattern with 2-foot radius). Sediment samples will be collected from a similar depth but will generally be discrete samples in order to retrieve material from specific, localized, surface water drainage features. Where soil and sediment samples may have been impacted by small arms fire, samples will be passed through an ASTM No. 10 (2-mm) wire mesh sieve at the laboratory prior to analysis for lead or selected metals in order to remove coarser particles and foreign objects, including large metallic lead fragments from bullets which have a low degree of bio-availability (Interstate Technology & Regulatory Council, 2003, *Characterization and Remediation of Soils at Closed Small Arms Firing Ranges*).

Surface water samples will be collected at a point down-gradient from Camp Abbot. Samples will be collected as a grab sample. Groundwater samples will be collected from existing well within or near an AOC. It is anticipated that private, domestic water wells will be sampled.

Samples for analysis of lead or selected metals will be tested for dissolved lead or metals and explosives of concern content.

The proposed sampling for the AOCs at Camp Abbot is summarized in Table 4.

Analyses

USEPA SW-846 Method 6020A will be used to analyze for lead or selected metals in soil and sediment. USEPA SW-846 Method 8330A/Modified 8330A will be used for selected explosives of concern analyses of soil, sediment, and water.

Background Sampling

Background soil samples are to be collected from 10 locations not impacted by Camp Abbot activities. Locations of the samples and evaluation methods of the background data will be presented in the SSWP. Samples will be analyzed for aluminum, barium, cadmium, chromium, cobalt, copper, iron, lead, magnesium, manganese, molybdenum, nickel, and zinc. This list includes metals commonly found in MC, plus several others used for geochemical evaluation to help evaluate background. Other metals typically included in the USEPA's TAL are not MC.

TPP Notes &
Data Quality Objectives

Site Inspection
Camp Abbot

Technical Project Planning Meeting
April 4, 2006

Technical Project Planning and Development of Data Quality Objectives

- The USACE TPP process is a four-phase process:
  - Identify the current project;
  - Determine data needs;
  - Develop data collection options; and
  - Finalize data collection program.
- The purpose of TPP is to develop DQOs that document how the project makes decisions.
- DQOs are intended to capture project-specific information such as the intended data use(s), data needs, and how these items will be achieved.
- Information captured through DQOs will be used as a benchmark for determining whether identified objectives are met.

TPP Phases

Phase I: Identify the Current Project

1. Team members identified to date include: USACE – representatives from the Omaha Design Center and the Seattle District; Shaw Environmental, Inc. as a USACE contractor; and ODEQ.

   Question: Is there any person or organization missing from this Team?

   U.S. EPA and U.S.D.A. Forest Service should be part of the review team

2. The AOCs are identified as:
   - Range Complex No. 1, a small arms range
   - Anti-Tank Range, an explosive munitions range
   - Demolition Area, an explosive munitions range *(combine with Mortar Range?)*
   - Mortar Range, an explosive munitions range (*combine with Demolition Area)*?
   - Grenade Courts
   - Burial Pit
   - Chemical Training Area

   Question: Are there any other AOCs to be identified?

   None

3. Based on information available about the site and shared through discussions with USACE, concerns about this area have been expressed by the ODEQ, as well as by local residents (who have discovered and reported MEC).

   Question: Are there additional concerns or issues from landowners or other stakeholders regarding the Camp Abbot area?

   None Identified

   Question: Are there any administrative or stakeholder concerns or constraints that would prevent site inspection activities from going forward on the decision path for this site?

   None Identified

Phase II: Determine Data Needs

4. Existing site information includes an ASR and ASR Supplement both prepared by the USACE in 1995 and 2004, respectively. A PA/SI was prepared for the USEPA in 2005:

   Weston Solutions, Inc. (Weston), 2005, *Camp Abbot FUDS Preliminary Assessment/Site Inspection Report*, TDD 01-08-0006, USEPA Contract 68-S0-01-02, prepared for U.S. Environmental Protection Agency, April

   Additional sources of historical information and regional setting are identified above in the Background Information section.

   Question: Are there any other pertinent documents relating to the site available?

   None Identified

5. The site-specific approach for this SI involves collating and assessing available site information, to include site geology, hydrogeology, groundwater, surface water, ecological information, human use/access, and current and future land uses; as well as considering conduct of site inspection and sampling activities.

   Question: Are there any other site aspects/information that should be considered?

   None Identified

6. Based on prior site investigations, soil is the primary affected medium at Camp Abbot. Surface water is a potential pathway of MC. Groundwater is also a potential pathway and is likely to discharge to surface water in major streams. Air is a potential pathway if soil particles become airborne; screening values for soil will be used that are protective of this

pathway. Considering current and future land use, receptors of any contaminants that may be present could include residents, workers, recreational users, livestock, pets, and wildlife.

Question: Do team members concur with the CSM?

- **MEC and MC will be evaluated at Range Complex No. 1**
- **MEC, and potentially MC depending on reconnaissance results, will be evaluated at Grenade Courts and Burial Pit.**
- **MC will be evaluated at explosive munitions ranges and live hand grenade courts; the presence of MEC at these AOCs is known based on past encounters with MEC.**
- **MC will be evaluated at Anti-Tank Range and Mortar Range.**
- **Chemical Training Area and Demolition Area do not require field investigations.**

Additional MC evaluations were identified for:
- *Surface water impacts*
- *Groundwater impacts*

7. Technical considerations and/or constraints need to be identified and addressed before conducting any additional sampling, and would depend on the approach and additional data needs decided upon by team members.

Questions:

- **Are any data missing?**
- **What is the nature of needed data?**
- **What data gaps would additional data meet for making a decision about the site?**
- **Are there any considerations/constraints that need to be addressed for collecting additional data?**

Additional data are needed to assess impacts to surface water and groundwater. Samples of both surface and groundwater will be collected and analyzed for explosives and metals. Data will answer questions as to whether MC has impacted water. No other conditions/constraints need to be addressed.

Phase III: Develop Data Collection Options

8. Proposed approach:

    1. Background sample locations will be determined using the software Visual Sampling Plan (VSP) or similar software.
    2. Conduct reconnaissance surveys for MEC and determine sample locations at Range Complex No. 1, Grenade Courts, and Burial Pit.
    3. Conduct reconnaissance for sampling and collect samples at Anti-Tank Range and Mortar Range.

Question: Based on the desired decision endpoints and information known to date, what additional information is needed to reach a determination of No Department of Defense Action Indicated (NDAI) or further action?

None Identified

Question: Are the stakeholders in agreement with the sampling approach program?

Yes

Question: Are the stakeholders in agreement with the proposed approach for collecting background data and comparison against sample data?

Stakeholders are in agreement with the number of samples to be collected. General approach was accepted. However, particular methodology will be presented in the SSWP and submitted for their review.

Phase IV: Finalize Data Collection Program

9. What concentrations of COCs lead to decision end-points?

Health-based screening values discussed at the TPP meeting included Oregon Soil Cleanup Levels (OAR 340-122-045), Maximum Allowable Soil Concentrations (OAR 340-122-045(7), and Leachate Reference Concentrations (OAR 340-122-045(6)(a); ODEQ indicated that these values would not be applied. ODEQ prefers Risk-Based Concentrations (RBCs) based on guidance for Risk-Based Decision Making Process for the Remediation of Petroleum-Contaminated Sites. For chemicals not addressed by the guidance, ODEQ commonly defaults to USEPA Region 9 PRGs. Table 5 lists Region 9 PRGs (Oregon RBCs for lead, the only COC for which RBCs are available, includes a Leaching to Groundwater RBC of 30 mg/kg, which is lower than Region 9 PRGs). Region 9 SSLs are also shown in Table 5. ODEQ is agreeable to scaling back the number of metals from the full TAL list.

Question: What approach is appropriate for evaluating ecological risk?

ODEQ Level II screening methodology is proposed for ecological screening as listed on Table 7

Question: To what extent are both total and leachate analytical results for metals (or lead) required to assess MC in soils and sediment?

Selected total metals (or lead) and explosives are the only analytical results required to assess MC in soils and sediments.

Question: Are there any additional sampling and analysis methodologies needed for all team members to arrive at a decision end-point?

None Identified

10. Assuming that additional data are needed for the former Camp Abbot FUDS SI, it is important for all team members to agree with the sampling strategy and analysis.

    Question: Given the additional sampling and analysis methodologies, are there impacts to the project schedule that need to be accommodated?

    None Identified

Data Quality Objectives

At the TPP meeting, it was agreed that the following decision rules would be applied with regard to MC sampling results.

- Below risk-based screening levels = NDAI;
- Above risk-based screening levels and background = RI/FS.

The following expanded project objectives have been developed.

Objective 1: Determine if the site requires additional investigation or can be recommended for NDAI based on the presence or absence of MEC.

DQO #1 – The presence of MEC is unknown at Range Complex No. 1, Grenade Courts, and Burial Pit. Utilizing trained UXO personnel and handheld magnetometers, a visual search of these AOCs will be conducted, searching for physical evidence to indicate the presence of MEC (e.g., craters, ground scars, soil discoloration, munitions debris, or MEC on the surface). The visual search will consist of a meandering path survey along trails and in accessible areas. The following decision rules will apply:

- If no evidence of MEC is found, the AOCs will be recommended for NDAI relative to MEC.
- If evidence of MEC is confirmed, the AOCs will be recommended for additional investigation.
- If there is indication of an imminent MEC hazard, the site may be recommended for a Time Critical Removal Action (TCRA).

DQO #2 – At AOCs where MEC has been reported in the past (Anti-Tank Range, Mortar Range/Demolition Area), the following decision rules will apply:

- The presence of MEC is confirmed on the basis of past finds, and these areas will be recommended for additional investigation.
- If, in the course of reconnaissance for sample targets and/or UXO avoidance, there is indication of an imminent MEC hazard, the site may be recommended for a TCRA.

Objective 2: Determine if the site requires additional investigation or can be recommended for NDAI based on the presence or absence of MC above screening values.

DQO#3 – Soil, sediment, and surface water samples will be collected and analyzed as proposed in Table 4. Analytical results will be compared to screening values for human health and ecological risk assessment, and to background values for naturally-occurring substances. The following decision rules will apply:

- If sample results are less than human health and ecological screening values, the site will be recommended for NDAI relative to MC.
- If sample results exceed both human health screening values and background values, the site will be recommended for additional investigation.
- If sample results do not exceed human health screening values but do exceed both ecological screening values and background values, additional evaluation of the data will be conducted in conjunction with the stakeholders to determine if additional investigation is warranted.

Objective 3: Obtain data required for HRS scoring.

Data required for HRS scoring are identified in the HRS Data Gaps worksheet.

Objective 4: Obtain data required for MRSPP ranking.

Data required for MRSPP ranking are identified in the MRSPP worksheet.

Next Steps

- Scheduling of a 2nd TPP meeting will occur as agreed upon by team members.
- Shaw will prepare the TPP Memorandum and distribute for concurrence.
- Shaw will prepare the SSWP for review and comment.
- Shaw will collect samples.
- Shaw will prepare the SI Report.

Figures

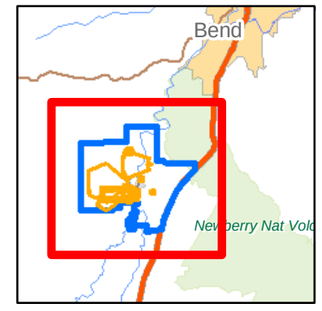
OFFICE: CEN
DRAWN BY: J. Lillis 1/13/06
DRAWING NUMBER: CABO_001_figXX_siteLayout

DEMOLITION AREA
MORTAR RANGE
BURIAL PIT
RANGE COMPLEX NO. 1
ANTI-TANK RANGE
CHEMICAL TRAINING AREA
GRENADE COURTS
Three Rivers
Sunriver Resort
Deschutes River
Kiwa Spring Rd
Natl Forest Develop Rd
California Hwy
Core Rd
Crawford Rd
Vandervert Rd
Cascade Rd
Overlook Rd
Fire Rd
Spring River Rd
River Rd
Abbot Dr
Meadow Rd
Nfd 4000 022
Nfd 4000 017
Nfd 9720 100
Nfd 9720 180
Nfd 9724 475
Nfd 9720 300
Nfd 9720 350
Nfd 9724 700
Nfd 9720 250
Nfd 9720 165
Nfd 9720 014
9710 020
9710 200
9710 240
9721 300
9710 280
Klak Butte Rd
Natl Forest Develop Rd
Winchester Rd
Stagestop Dr
Pistol Bu Rd
Century Dr
Big River Dr
Gatehouse Ln
Gross Dr
Forest Ln
Foster Rd
Swan Rd
Snow Goose Rd
Osprey Rd
Redington Dr
Sharp Dr
Pitch Ct
Upland Rd
Brant Dr
Sandpiper Rd
Twin Rivers Dr
Hashknife Rd
Blue Eagle Rd
Huntington Rd
Heidi Ct
Injury Dr
Nest Pine Dr
Rail Dr
Pasadena Rd
Merced Rd
Laguna Rd
Jacinto Rd
Indio Rd
Elsinore Rd
Covina Rd
Azusa Rd
Besson Rd
Vista Ln
Abbot Dr
Wolf Ln
Beaver Dr
Sandhill Ln
Whistler Dr
Lake Rd
Klamath
Sumac
Cascade Rd
Siskiyou
Tournament Ln
Mcnary Ln
Camnaha Rd
Cabe Camp Dr
Solar Dr
Meteor Dr
Stellar Dr
Three Duck Rd
Elder Rd
97

Legend

- Camp Abbot Property Boundary
- Camp Abbot AOCs
- Monitoring Wells
- Privately Owned Land
- Federal Energy Regulatory Commission
- Bureau of Land Management
- Oregon Department of State Lands
- US Department of Agriculture Forest Service

NOTES:
1) AOC boundaries were derived from the Camp Abbot ASR Supplement.
2) Groundwater well data were obtained from the US Geological Survey (USGS).
3) Land ownership shapefile was obtained from the Oregon Geospatial Data Clearinghouse (http://www.gis.state.or.us/data/alphalist.html).
4) These ranges are located within the Upper Deschutes Watershed.



N

0 0.5 1 2
Miles

REFERENCE/PROJECTION: State Plane NAD 83 UTM Zone 10N

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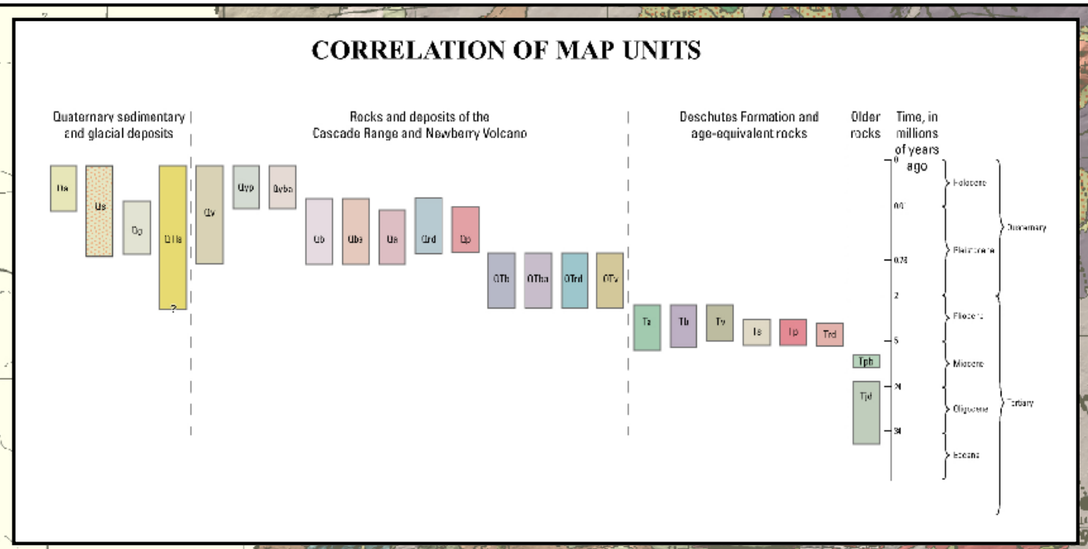
FIGURE 1

SITE LAYOUT

CAMP ABBOT

Shaw Shaw Environmental, Inc.

OFFICE	DRAWN BY	DRAWING NUMBER
MNRV	K. Masterson 3/29/06	CABO_010_fig02_geologic



Legend

Camp Abbot Property Boundary

Source: From Lite et al., 2002, Geologic Framework of the Regional Ground-Water Flow System in the Upper Deschutes Basin, Oregon, Plate 1.

N

0 2.5 5 10 Miles

REFERENCE/PROJECTION: NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 2

GEOLOGIC MAP OF THE CAMP ABBOT AREA

CAMP ABBOT

Shaw Shaw Environmental, Inc.

OFFICE MNRV | DRAWN BY K.Masterson 3/29/06 | DRAWING NUMBER CABO_011_fig03_GeoCrossSect

DESCRIPTION OF MAP UNITS

(Map-unit descriptions generalized from those found in Sources of Mapping)

Quaternary sedimentary and glacial deposits

Qal **Alluvial deposits (Holocene)**—Sand, gravel, and silt along channels and flood plains of the present-day drainage system.

Qs **Alluvium and glacial outwash deposits (Holocene and Pleistocene)**—Silt, sand, and gravel primarily from reworked late Pleistocene glacial deposits in the Cascade Range, and basin-filling deposits from several sources.

Qg **Glacial till (Holocene and Pleistocene)**—Poorly sorted silt, sand, cobbles, and boulders deposited as ground and lateral moraines primarily during the Cabot Creek and Jack Creek glaciations of Scott (1977).

QTls **Landslide deposits (Holocene to Pliocene?)**—Slumped blocks of sedimentary rock, tuff, and basalt primarily along valley walls of the major streams.

Rocks and deposits of the Cascade Range and Newberry Volcano

Qv **Volcanic vents (Holocene and Pleistocene)**—Cinders, bombs, blocks, domes, and thick flows that mark basalt, andesite, dacite and rhyolite vents of the Cascade Range and Newberry Volcano.

Qyp **Young pyroclastic deposits (Holocene)**—Pumiceous ash and lapilli tephra fallout and pumiceous ash-flow deposits from Crater Lake (ancestral Mt. Mazama) and Newberry Volcano.

Qyba **Young basalt, basaltic andesite, and andesite (Holocene)**—Young basalt, basaltic andesite, and andesite lava flows that occur in and adjacent to the Cascade Range and on the flanks of Newberry Volcano.

Qb **Basalt (Holocene and Pleistocene)**—Gray, aphanitic to porphyritic lava flows, often open textured and containing some olivine. Primary sources include Newberry Volcano and Mount Bachelor, but the unit also is associated with several smaller vents in the Cascade Range. This unit includes much basaltic andesite on the upper flanks of Newberry Volcano and along the Mount Bachelor chain, and intracanyon flows in the vicinity of Lake Billy Chinook.

Qba **Basaltic andesite (Holocene? and Pleistocene)**—Gray, aphanitic to slightly porphyritic lava flows of the Cascade Range. Most flows are Pleistocene; all have normal-polarity thermal remanent magnetization and are therefore younger than 0.78 million years.

Deschutes Formation and age-equivalent rocks

Ta **Andesite (Pliocene and Miocene)**—Includes andesite of McKinney Butte and lava flows interbedded within the Deschutes Formation. Also includes andesite plug, breccia, and lava flows of Castle Rocks volcano.

Tb **Basalt (Pliocene and Miocene)**—Generally open-textured, typically olivine bearing basalt flows in the Deschutes Basin, High Lava Plains, and at Walker Rim. Includes Pelton basalt and Opal Springs basalt members of the Deschutes Formation.

Tv **Volcanic vents (Pliocene and Miocene)**—Basalt and basaltic andesite shield volcanoes, cones, tuff, and breccia that mark eruptive centers. Includes deposits forming Awbrey Butte, Long Butte, Squaw Back Ridge, Little Squaw Back, and Steamboat Rock.

Ts **Sedimentary deposits (Pliocene and Miocene)**—Primarily sedimentary rocks of the Deschutes Formation. Includes inactive margin, arc-adjacent plain, and ancestral Deschutes River channel facies of Smith (1986b).

Tp **Pyroclastic deposits (Pliocene and Miocene)**—Ash-flow tuff of the Deschutes Formation (Smith,1986b) and the Peyerl Tuff (MacLeod and Sherrod, 1992).

Trd **Rhyolite and rhyodacite (Pliocene and Miocene)**—Rhyolite and rhyodacite domes and related deposits. Includes Cline Buttes and the dome complex near Steelhead Falls.

Older rocks

Tpb **Prineville Basalt (Miocene)**—Dark-gray, fine-grained, aphyric lava flows. Chemically distinct (e.g. high P_2O_5, high barium) from younger overlying lava flows (Hooper and others, 1993).

Tjd **John Day Formation (Miocene to Eocene)**—Complex assemblage of lava flows, pyroclastic deposits, sedimentary strata, and volcanic vent deposits (Smith and others, 1998). Strata of similar age and stratigraphic position to the John Day Formation are included in this unit on cross sections beneath the Cascade Range.

OW **Open water**

SN **Permanent ice and snow**

Qa **Andesite (Pleistocene)**—Porphyritic lava flows of the Cascade Range, commonly containing phenocrysts of plagioclase, orthopyroxene, and clinopyroxene. All have normal-polarity thermal remanent magnetization.

Qrd **Rhyolite, dacite, and rhyodacite (Holocene and Pleistocene)**—Porphyritic lava flows found mostly in the Three Sisters area and near the summit of Newberry Volcano.

Qp **Pyroclastic flow deposits (Pleistocene)**—Andesitic to rhyolitic ash-flow deposits of the Cascade Range and Newberry Volcano. Includes ash-flow deposits in the vicinity of Bend (e.g. Tumalo tuff, Shevlin Park tuff).

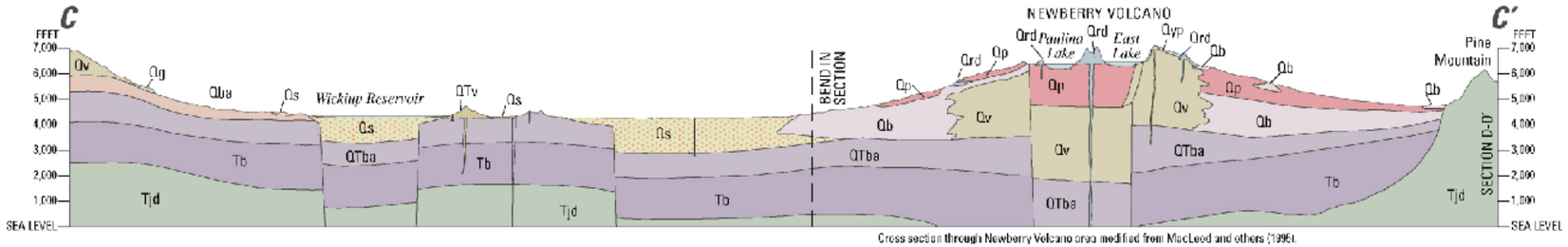
QTb **Basalt (Pleistocene and Pliocene)**—Generally open-textured, commonly vesicular lava flows. Mapped in the Millican area and south and southeast of Pine Mountain.

QTba **Basaltic andesite (Pleistocene and Pliocene)**—Primarily Pleistocene in age and compositionally similar to younger basaltic andesite flows in the Cascade Range. Contains both normal- and reverse-polarity remanent magnetization.

QTrd **Rhyolite and rhyodacite (Pleistocene and Pliocene)**—Chiefly domes and thick lava flows in the Cascade Range.

QTv **Volcanic vents (Pleistocene and Pliocene)**—Cinders, bombs, blocks, lapilli tuff, tuff breccia, domes, and thick flows that mark older basalt, basaltic andesite, dacite, and rhyolite vents, and maars and tuff rings within the Cascade Range.

Source: From Lite and others, 2002, Geologic Framework of the Regional Ground-Water Flow System in the Upper Deschutes Basin, Oregon, Plate 1



Cross section through Newberry Volcano area modified from MacLeod and others (1995).

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FIGURE 3

GEOLOGIC CROSS SECTION NEAR CAMP ABBOT

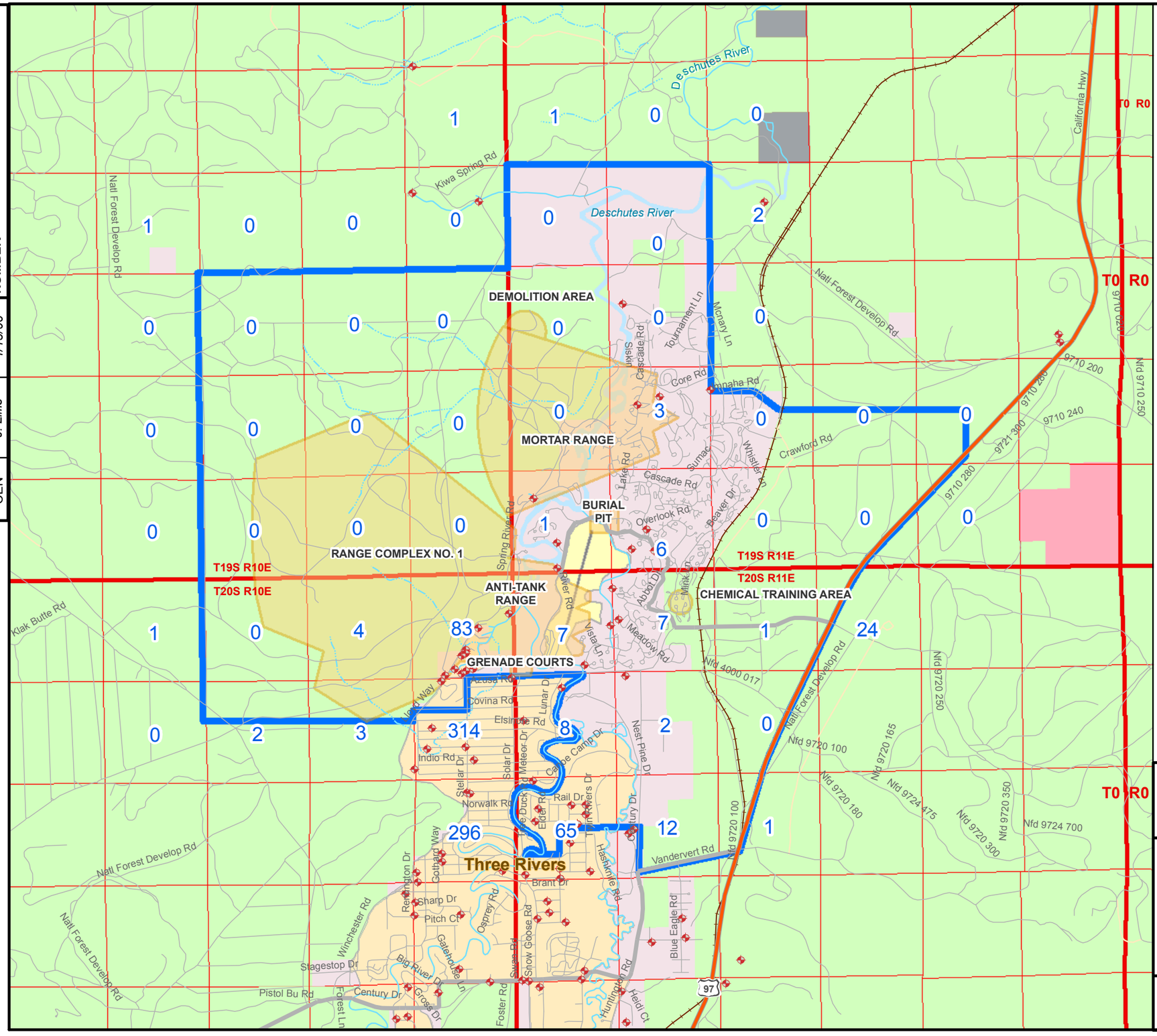
CAMP ABBOT

Shaw Shaw Environmental, Inc.

DRAWING NUMBER: CABO_009_fig04_SiteLayout_gwWells

DRAWN BY: J. Lillis 1/13/06

OFFICE: CEN



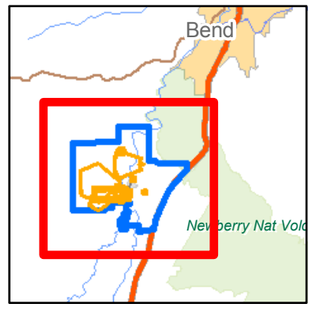
Legend

- Camp Abbot Property Boundary
- Camp Abbot AOCs
- Well (Source: USGS)
- Township and Range
- 4 — Section Line/No. of Well Records in Section*
- Privately Owned Land
- Federal Energy Regulatory Commission
- Bureau of Land Management
- Oregon Department of State Lands
- US Department of Agriculture Forest Service

Sectionalized Township Section Number

6	5	4	3	2	1
7	8	9	10	11	12
18	17	16	15	14	13
19	20	21	22	23	24
30	29	28	27	26	25
31	32	33	34	35	36

*Note: Number of well records per section from Oregon Water Resources Department database.



REFERENCE/PROJECTION: State Plane NAD 83 UTM Zone 10N

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FIGURE 4

GROUNDWATER WELL DATA

CAMP ABBOT

Shaw™ Shaw Environmental, Inc.

DRAWING NUMBER: CABO_008_fig05_RngComp1

DRAWN BY: J. Lillis 1/13/06

OFFICE: CEN

US FOREST SERVICE

RANGE COMPLEX NO. 1

FIELD TARGET & SUB-MACHINE GUN RANGE

LANDSCAPE RANGE

RIFLE RANGE

RIFLE / MACHINE GUN RANGE

TRANSITION RANGE

ANTI-AIRCRAFT RANGE

US FOREST SERVICE

Three Rivers

Legend

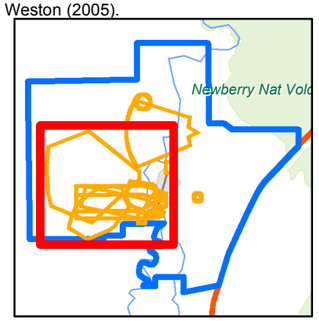
- Camp Abbot Property Boundary
- Camp Abbot AOCs
- Taxlot Parcels
- Monitoring Wells
- Proposed Sediment Sample Location
- Proposed Soil Sample Location

Weston PA/SI Sample Points[5]

- Soil Sample
- Sediment Sample
- Surface Water Sample
- Weston PA/SI XRF Screening Area[5]

NOTES:

1) AOC Boundaries were derived from the Camp Abbott ASR Supplement.
2) Groundwater well data were obtained from the US Gelogical Survey (USGS).
3) Taxlot parcel data were obtained from the Deschutes County GIS office.
4) These ranges are located within the Upper Deschutes Watershed.
5) Obtained from Camp Abbot FUDS Preliminary Assessment/ Site Inspection Report, Weston (2005).



N

0 875 1,750 3,500 Feet

REFERENCE/PROJECTION: State Plane NAD 83 UTM Zone 10N

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FIGURE 5

AREA OF CONCERN
RANGE COMPLEX NO. 1

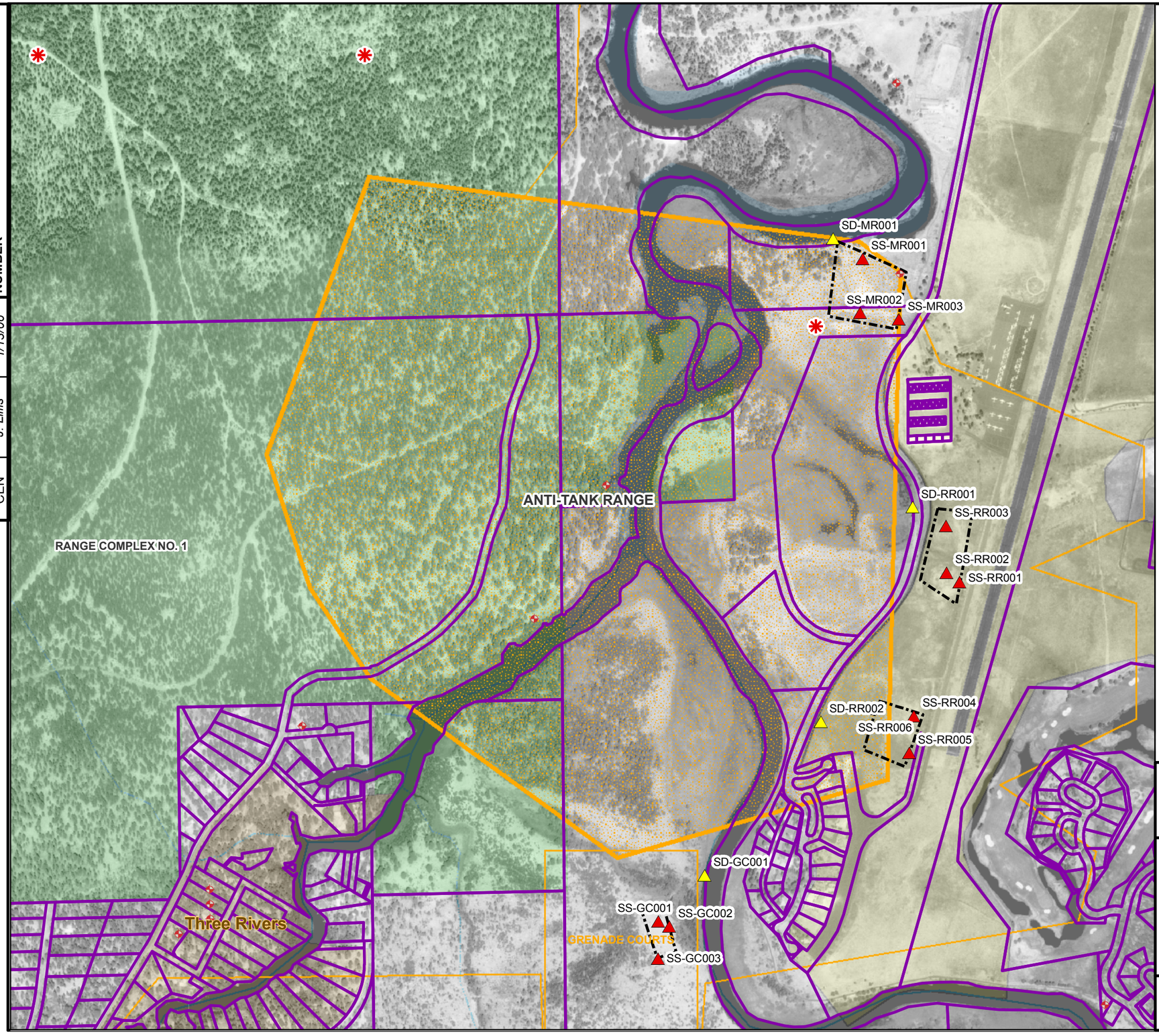
CAMP ABBOT

Shaw Shaw Environmental, Inc.

OFFICE CEN

DRAWN BY J. Lillis 1/13/06

DRAWING NUMBER CABO_003_fig06_AntiTankRng



Legend

- Camp Abbot Property Boundary
- Camp Abbot AOCs
- Taxlot Parcels
- Monitoring Wells
- Proposed Soil Sample Location

Weston PA/SI Sample Points[5]

- Soil Sample
- Sediment Sample
- Surface Water Sample
- Weston PA/SI XRF Screening Area[5]

NOTES:

1) AOC Boundaries were derived from the Camp Abbot ASR Supplement.
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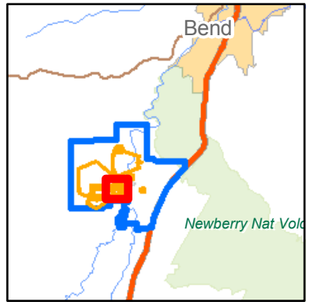
4) These ranges are located within the Upper Deschutes Watershed.
5) Obtained from Camp Abbot FUDS Preliminary Assessment/ Site Inspection Report, Weston (2005).



N

0 350 700 1,400 Feet

REFERENCE/PROJECTION: State Plane NAD 83 UTM Zone 10N

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FIGURE 6

AREA OF CONCERN
ANTI-TANK RANGE

CAMP ABBOT

Shaw Shaw Environmental, Inc.

DRAWING NUMBER *CABO_005_fig07_DemoArea*

DRAWN BY *J. Lillis* *1/13/06*

OFFICE CEN

DEMOLITION AREA

CONCRETE PILLBOX

SS-DP003

SS-DP002

SS-DP001

MORTAR RANGE

Sediment Sample SD-DP001
Located Approx. 0.75 miles SE

Legend

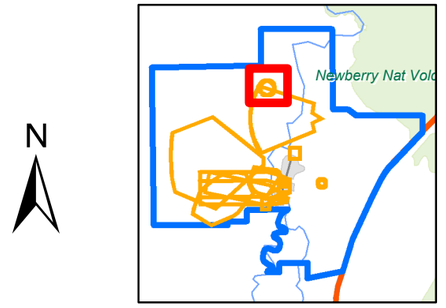
- Camp Abbot Property Boundary
- Camp Abbot Approximate AOC Boundary
- Taxlot Parcels
- Monitoring Wells

Weston PA/SI Sample Points[5]

- Soil Sample
- Sediment Sample

NOTES:

1) AOC Boundaries were derived from the Camp Abbot ASR Supplement.
2) Groundwater well data were obtained from the US Gelogical Survey (USGS).
3) Taxlot parcel data were obtained from the Deschutes County GIS office.
4) These ranges are located within the Upper Deschutes Watershed.
5) Obtained from Camp Abbot FUDS Preliminary Assessment/ Site Inspection Report, Weston (2005).



N

0 250 500 1,000 Feet

REFERENCE/PROJECTION: State Plane NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 7

AREA OF CONCERN
DEMOLITION AREA

CAMP ABBOT

Shaw Shaw Environmental, Inc.

DRAWING NUMBER: CABO_007_fig08_MortarRng

DRAWN BY: J. Lillis 1/13/06

OFFICE: CEN

DEMOLITION AREA

SS-DP003

SS-DP002

SS-DP001

MORTAR RANGE

US FOREST SERVICE

BURIAL PIT

SS-LF001

SS-LF002

SD-LF001

SW-LF001

RANGE COMPLEX NO. 1 -
FIELD TARGET & SUB-MACHINE GUN RANGE

Legend

- Camp Abbot Property Boundary
- Camp Abbot Approximate AOC Boundaries
- Taxlot Parcels
- Reported MEC Find Area
- Monitoring Wells
- Proposed Sediment Sample Location
- Proposed Soil Sample Location
- Proposed Surface Water Sample Location

Weston PA/SI Sample Points[5]

- Soil Sample
- Sediment Sample
- Surface Water Sample
- Weston PA/SI XRF Screening Area[5]

NOTES:
1) AOC Boundaries were derived from the Camp Abbot ASR Supplement.
2) Groundwater well data were obtained from the US Gelogical Survey (USGS).
3) Taxlot parcel data were obtained from the Deschutes County GIS office.
4) These ranges are located within the Upper Deschutes Watershed.
5) Obtained from Camp Abbot FUDS Preliminary Assessment/ Site Inspection Report, Weston (2005).

N

0 625 1,250 2,500

Feet

REFERENCE/PROJECTION: State Plane NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 8

AREA OF CONCERN MORTAR RANGE

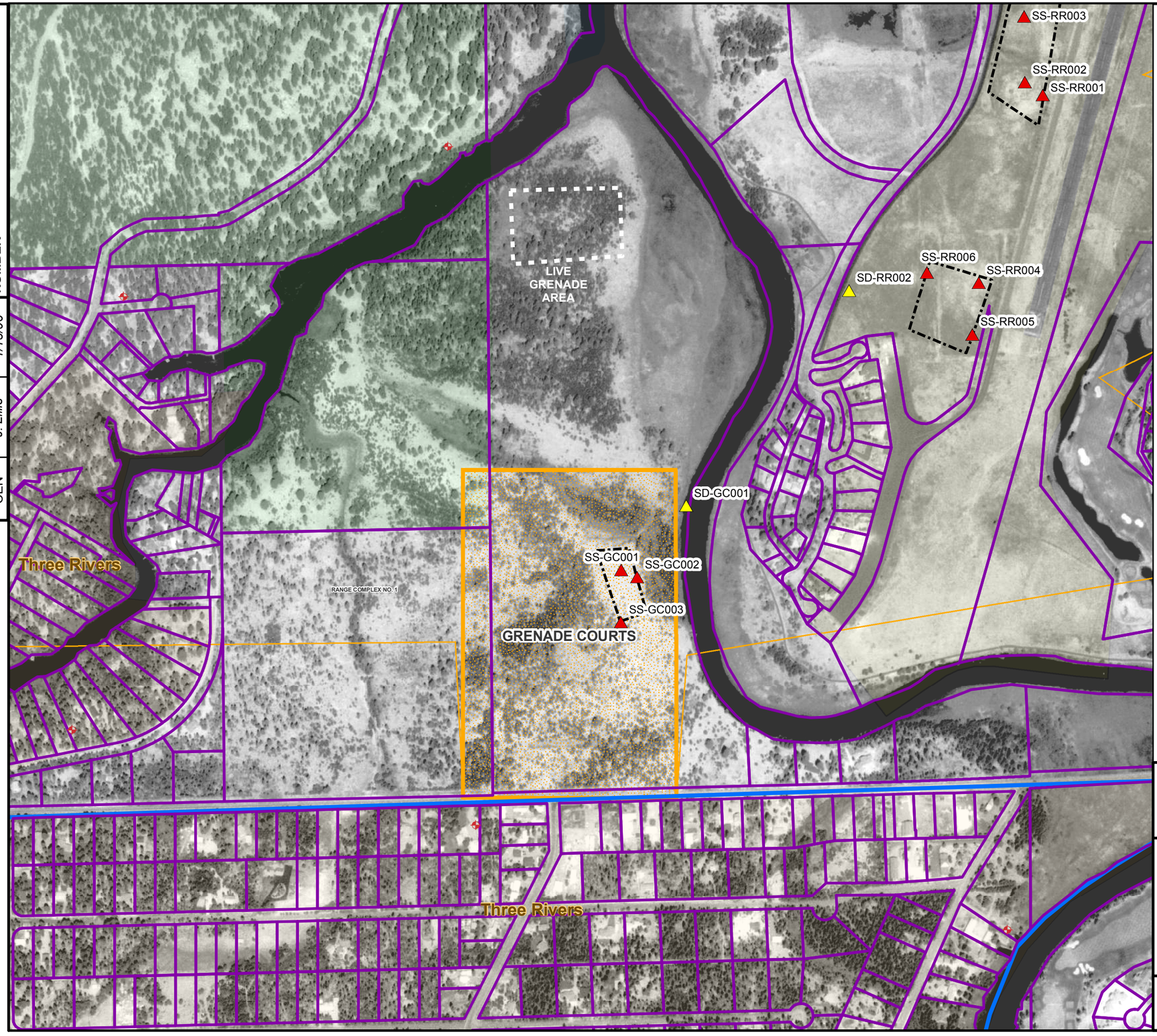
CAMP ABBOT

Shaw Environmental, Inc.

DRAWING NUMBER *CABO_004_fig09_GrenadeCts*

DRAWN BY *J. Lillis* *1/13/06*

OFFICE CEN



Legend

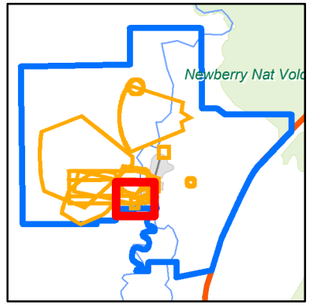
- Camp Abbot Property Boundary
- Camp Abbot AOCs
- Taxlot Parcels
- Monitoring Wells

Weston PA/SI Sample Points[5]

- Soil Sample
- Sediment Sample
- PA/SI XRF Screening Area[5]
- Live Grenade Area[6]

NOTES:

1) AOC Boundaries were derived from the Camp Abbot ASR Supplement.
2) Groundwater well data were obtained from the US Gelogical Survey (USGS).
3) Taxlot parcel data were obtained from the Deschutes County GIS office.
4) These ranges are located within the Upper Deschutes Watershed.
5) This information was obtained from the Camp Abbot FUDS Preliminary Assessment/Site Inspection Report, Weston, April 2005.
6) Area identified in Camp Abbot ASR, Appendix D.



N

0 150 300 600

Feet

REFERENCE/PROJECTION: State Plane NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 9

AREA OF CONCERN
GRENADE COURTS

CAMP ABBOT

Shaw Shaw Environmental, Inc.

OFFICE	DRAWN BY		DRAWING NUMBER
CEN	J. Lillis	1/13/06	CABO_002_fig10_BurialPit

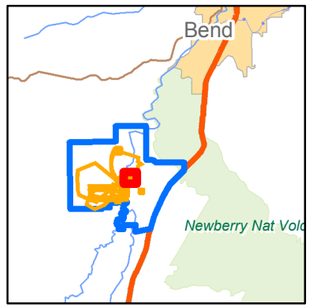
Legend

- Camp Abbot Property Boundary
- Camp Abbot AOCs
- Taxlot Parcels
- Monitoring Wells

Sample Points from PA/SI (Weston, 2005)[5]

- Soil Sample
- Sediment Sample
- Surface Water Sample

NOTES:
1) AOC Boundaries were derived from the Camp Abbot ASR Supplement.
2) Groundwater well data were obtained from the US Gelogical Survey (USGS).
3) Taxlot parcel data were obtained from the Deschutes County GIS Office.
4) These ranges are located within the Upper Deschutes Watershed.
5) Obtained from Camp Abbot FUDS Preliminary Assessment/ Site Inspection Report, Weston (2005).



N

0 200 400 800
Feet

REFERENCE/PROJECTION: State Plane NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 10

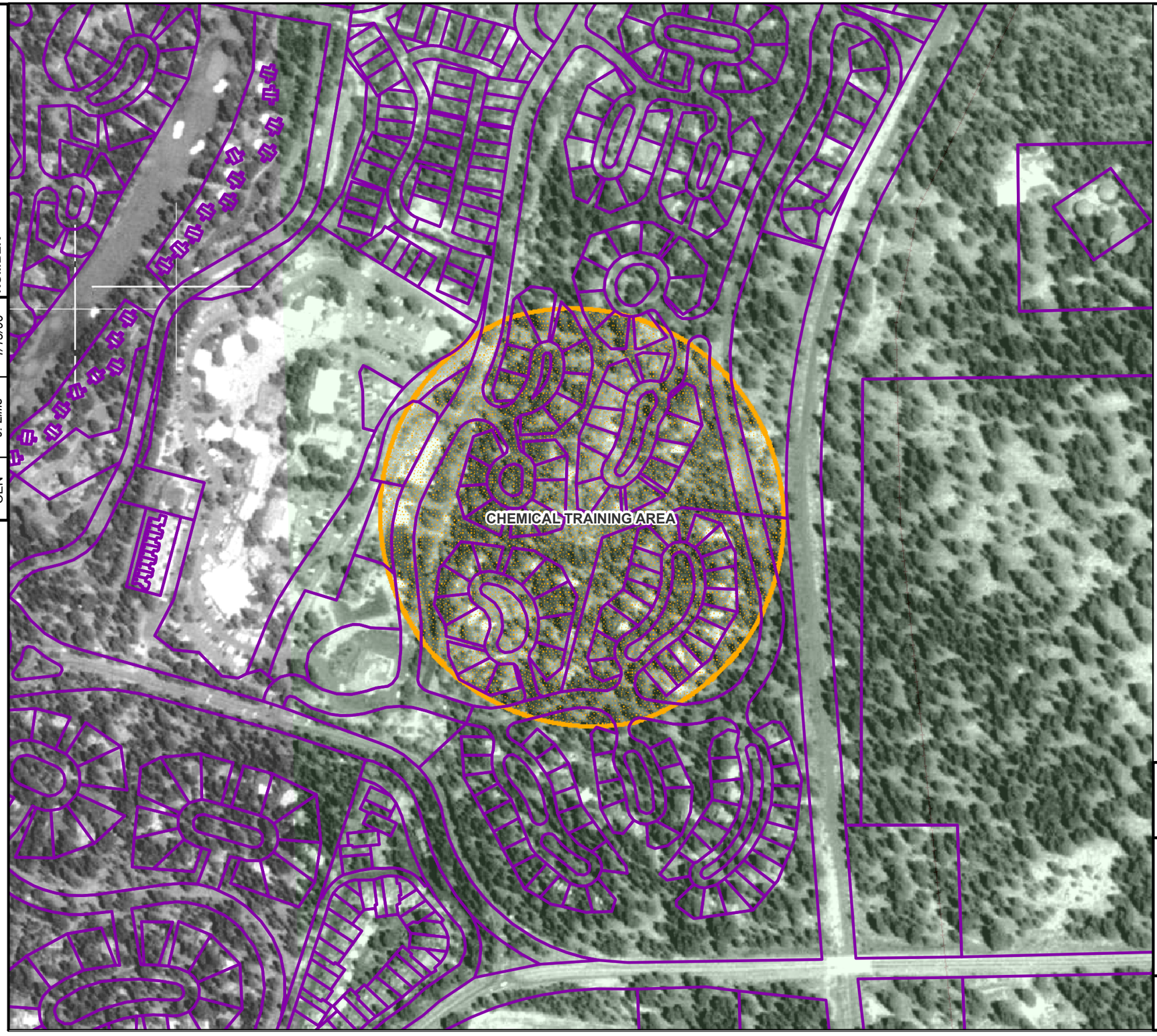
AREA OF CONCERN
BURIAL PIT

CAMP ABBOT

Shaw Shaw Environmental, Inc.

OFFICE	DRAWN BY	
CEN	J. Lillis	1/13/06

DRAWING NUMBER *CABO_004_fig11_ChemTrainArea*

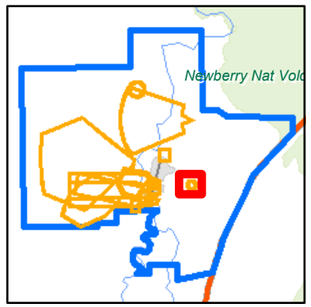


Legend

- Camp Abbot Property Boundary
- Camp Abbot AOCs
- Taxlot Parcels
- Monitoring Wells

NOTES:

1) AOC Boundaries were derived from the Camp Abbot ASR Supplement.
2) Groundwater well data were obtained from the US Gelogical Survey (USGS).
3) Taxlot parcel data were obtained from the Deschutes County GIS office.
4) These ranges are located within the Upper Deschutes Watershed.



N

0 150 300 600

Feet

REFERENCE/PROJECTION: State Plane NAD 83 UTM Zone 10N

U.S. ARMY CORPS OF ENGINEERS
OMAHA DESIGN CENTER

FIGURE 11

AREA OF CONCERN
CHEMICAL TRAINING AREA

CAMP ABBOT

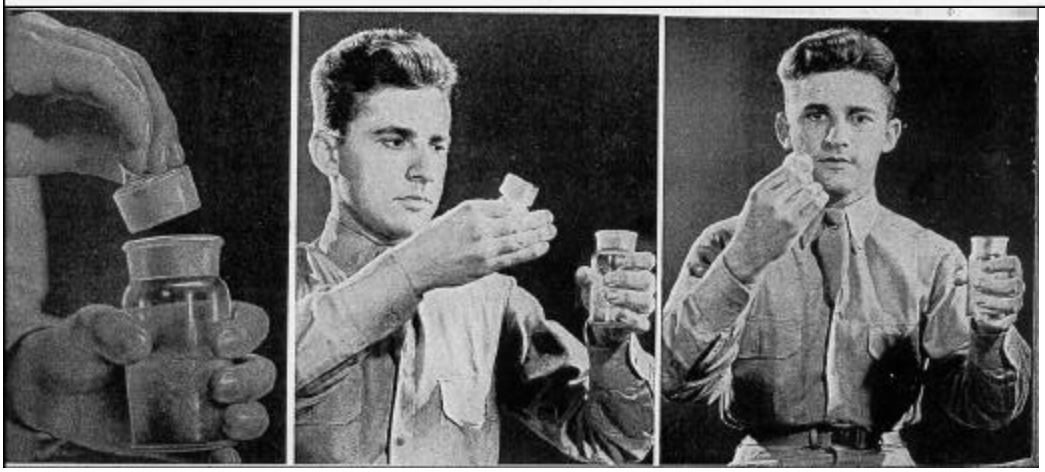
Shaw Environmental, Inc.

Photographs

Photograph 1. Soldiers undergoing training in gas chamber at Camp Abbot.

Photograph 2. M1 Instructional Gas Identification "Sniff" Set.

Instructional gas identification set, MI, showing method of packing.



Tables

Table 1
Potential MEC and MC at Camp Abbot Areas of Concern

AOC	Munitions	Munitions Constituents	Land Use Controls [1]
Range Complex No. 1	Small Arms General	Lead, single or doublebase black powder	No
Anti-Tank Range	M6A1, Rocket, HEAT, 2.36 inch	Pentolite, Ballistite	No
	M6A3, Rocket, HEAT, 2.36 inch	Pentolite, Ballistite	
	M31 Rifle Grenade HEAT	Comp. B	
	M9A1 Rifle Grenade Anti-Tank	Pentolite or TNT	
	M11A2 Practice Rifle Grenade	Inert	
	M7A1, Practice Rocket, 2.36 inch	5 Sticks of Ballistite	
	M7A3, Practice Rocket, 2.36 inch	5 Sticks of Ballistite	
Demolition Area	Explosives Detonating Cord	PETN, Black Powder	No
	Explosives Dynamite Commercial	Nitroglycerin	
	Explosives TNT	TNT	
	Detonators	No Data sheets provided	
	Blasting Caps Electric Commercial	Sensitive Explosive	
	Fuses, Boosters, or Bursters	No data sheets provided	
Mortar Range	60mm HE M49	TNT, Ballistite	No
	60mm Practice M50A2	Inert with black powder pellets	
	81mm, HE, M43	TNT, Ballistite	
	81mm, TP M43A1	Black Powder	
Grenade Courts	Mk II, Hand Grenade, Frag	TNT (Flaked or Granular), older models used Smokeless Black Powder (nitrocellulose, charcoal, and sulfur)	No
	AN-M8 Smoke Grenade HC	Hexachloroethane-zinc	
	AN-M14, Incendiary Grenade	Igniter mixture III, Delay mixture V, FF mixture VII, incendiary mixture, Thermite, TH3 and thermite, plain.	
	M15, Smoke Grenade, WP	White Phosphorous	
	M21, Practice Hand Grenade	Black Powder	

Table 1 (Cont.)
Potential MEC and MC at Camp Abbot Areas of Concern

AOC	Munitions	Munitions Constituents	Land Use Controls [1]
Burial Pit	Small Arms General	Lead, single or doublebase black powder	No
	Small Arms General-complete rounds	No data sheets provided	
	Mk II, Hand Grenade, Frag	TNT (Flaked or Granular), older models used Smokeless Black Powder (nitrocellulose, charcoal, and sulfur)	
	AN-M14, Incendiary Grenade	Igniter mixture III, Delay mixture V, FF mixture VII, incendiary mixture, Thermite, TH3 and thermite, plain.	
	M15, Smoke Grenade, WP	White Phosphorous	
	M6A1, Rocket, HEAT, 2.36 inch	Pentolite, Ballistite, M400	
	M7A1, Practice Rocket, 2.36 inch	5 Sticks of Ballistite	
	60mm, HE, M49	TNT, Ballistite	
	81mm, HE, M43	TNT, Ballistite	
	60mm, Practice, M50A2	Inert with black powder pellets	
	Riot Control Agents	No data sheets provided	
	Less Sensitive Explosives (Ammonium Nitrate, Explosive D, etc.	No data sheets provided	
	Chemical ID, Toxic Gas Set M2	28 Heat-sealed Ampoules with 3.8 ounces of Mustard	
	Toxic Chemical Munitions	No data sheets provided	
Chemical Training Area	AN-M8 Smoke Grenade HC	Hexachloroethane-zinc	No
	AN-M14, Incendiary Grenade	Igniter mixture III, Delay mixture V, FF mixture VII, incendiary mixture, Thermite, TH3 and thermite, plain.	
	M15, Smoke Grenade, WP	White Phosphorous	
	Pot Tear Gas M1	Chloracetophenone mixture	
	Chemical ID, Toxic Gas Set M2	28 Heat-sealed Ampoules with 3.8 ounces of Mustard	
	Chemical ID, Toxic Gas Set M1	24 bottles of 32 ounces of Mustard or Distilled Mustard	
	Toxic Chemical Munitions	No data sheets provided	

[1] ASR Supplement, USACE, 2004.

Table 2
Summary of Reported MEC Encounters at Camp Abbot

Document	Attributed Source	Date of Encounter	Reported MEC Encounter
ASR Supplement, 2004	NA	NA	"A 2.36" anti-tank rocket was found in this area [Anti-Tank Range]"
ASR Supplement, 2004	NA	NA	"Duds of 60 and 81mm mortars were found in the area [Mortar Range]."
ASR, 1995 (p. 4-2)	O'Reilly, 1989	NA	"A historical brochure published by Sunriver states that a group of youths found bazooka rockets, bullets, hand grenades and barbed wire that were used in the engineers' bivouac training (O'Reilly 1989)."
ASR, 1995 (p. 6-1)	ASR team	22-23 May, 1995	"The only ordnance related item observed on the site was a grenade spoon, in the vicinity of the grenade courts [N 43° 58' 52.1", W 120° 03' 08.0"]."
ASR, 1995 (p. 6-1)	NA	NA	"Items [reportedly found on site] observed in the display cabinet [of the Sunriver Nature Center] included parts of a grenade, a 2.36" bazooka round, and different caliber bullets."
ASR, 1995 (p. 6-1)	NA	NA	"Ordnance has reportedly been found in the cliffs northwest of the airport."
ASR, 1995 (p. H-3)	Sgt. Terry Silbaugh, Deschutes County Sheriff's Office	NA	"Sgt. Silbaugh stated that ordnance has been recovered near the areas of Milliken and Alfalfa. These lands are within the former maneuver area but are also near the Redmond Precision Bombing Range."
ASR, 1995 (p. H-3)	Sue Hinton, Sunriver Nature Center	NA	"Actual pieces of ordnance have been kept and maintained by the Sunriver Nature Center."
INPR, 1993 (RAC Work-sheet , pp. 4-8)	Joe Hunt, Bend Ranger District Resource Assistant; Deschutes County Emergency Services; Sunriver Nature Center	NA	"An artillery round and a bazooka round were found west of the Sunriver Resort [across the Deschutes River]. In addition, spent mortar and rocket rounds have been found northwest of the Sunriver airstrip."
INPR, 1993 (Contact Listing)	Jill Ortlery, U.S. Forest Service	1988	"Ms. Ortlery contacted the Corps of Engineers…concerning a bazooka round she 'kicked out of the ground', west of Sunriver…The location was approximately 1-1/2 miles west of Sunriver on Forest Road 40. The site was in a beetle kill area and was opened to the general public for wood cutting in 1988."
INPR, 1993 (Contact Listing)	Sgt. Terry Silbaugh, Deschutes County Emergency Services, County Sheriff's Office	1988	"Concerning the bazooka round found by Ms. Orterly of the Forest Service…Sgt. Silbaugh had called the 53rd Ordnance Detachment from Yakima Firing Range, Washington…after the Sheriff's Office sent someone out to look at the round. The markings were deteriorated…The 53rd …identified the round to be a '2.36-inch rocket, of late World War II or Korean War vintage that was probably used for Anti-Tank warfare."
INPR, 1993 (Contact Listing)	Sgt. Terry Silbaugh, Deschutes County Emergency Services, County Sheriff's Office	NA	"Apparently, an artillery round was discovered west of Sunriver, and the Deschutes County Emergency Services office was contacted."
INPR, 1993 (Contact Listing)	Mr. David Danley, Sunriver Nature Center	NA	"Spent mortar and rocket rounds are still occasionally found near a cliff N.W. of the airstrip (across Cardinal landing bridge)."

Table 3
MEC and MC Exposure Pathway Analysis – Range Complex No. 1 (Small Arms Ranges)

Range Area & Type	MMRP Concern	Potential Contaminant of Concern (PCOCs)	Affected Media (Potential Contaminant Sources) (Fate and Transport)	PCOC Concentrations Exceed Screening Levels	Exposure Routes and Potential Receptors			Data Gaps	Activities to Address Data Gaps (i.e., Sampling)
					Site Workers/ Contractor Personnel	Residents/ General Public	Ecological		
Range Complex No. 1	**MEC**	MEC in the form of unused or discarded small arms rounds or other unknown munitions.	**Surface & Subsurface Soils** • Low hazard associated with small arms rounds (stable, non-explosive projectiles). Potential for unknown explosive MEC sources.	Not Applicable	• Potentially complete pathway. • Exposure routes: - Vehicle traffic - Foot traffic - Intrusive activities - Geologic instability	• Potentially complete pathway. • Exposure routes: - Vehicle traffic - Foot traffic - Intrusive activities - Geologic instability	• Potentially complete pathway. • Exposure routes: - Foot traffic - Burrowing - Geologic instability	• Presence of MEC is unknown, except area that overlaps Anti-Tank Range (where MEC is known)	Visual reconnaissance and localized magnetometer sweeps will be conducted to: • Assess presence of MEC, • Practice MEC avoidance, and • Select appropriate sample locations.
	MC	Lead Antimony and copper (in lower concentrations than lead; therefore inspection will focus on lead)	**Soil** • Affected by lead projectiles on or within the ground.	**YES –** Complete or Potentially Complete Pathways →	• Potentially complete pathway. • Exposure routes (during intrusive work): - incidental ingestion, - dermal contact, and - inhalation of soil particulates.	• Potentially complete pathway. • Exposure routes (during intrusive work): - incidental ingestion, - dermal contact, and - inhalation of soil particulates.	• Potentially complete pathway. • Exposure routes: - ingestion, and - direct contact by area fauna.	• Analytical data do not exist for some subranges.	• Composite soil samples will be analyzed for lead. Soil samples for lead will be sieved (#10 sieve) by the laboratory prior to analysis.
				NO – Incomplete Pathway					
			Surface Water /Sediment • Potentially affected (streams). • Fate & Transport: via surface runoff from impacted soil.	**YES –** Complete or Potentially Complete Pathways →	• Potentially complete pathway. • Exposure routes: - incidental ingestion, - dermal contact, and - inhalation of surface water.	• Potentially complete. • Exposure - ingestion, - dermal contact, and - inhalation of water mist or vapor.	• Potentially complete pathway. • Exposure routes: - ingestion, and - direct contact by area fauna.	• Analytical data do not exist for some subranges.	• Impact to surface water will be addressed via primarily affected medium – soil. Locations of potential soil sources are known from historical maps. Will address surface water pathway with soil data; impact to surface water will conservatively be assumed if soil contamination is identified. • Surface water potentially impacted from the previously unsampled subranges will be addressed by sampling sediment from surface water pathway for lead.
				NO – Incomplete Pathway					
			Groundwater • Potentially affected media. • Fate & Transport: migration to groundwater via infiltration.	**YES –** Complete, Potentially Complete, or Incomplete Pathways →	• Potentially complete pathway. • Exposure routes (during intrusive work): - incidental ingestion, - dermal contact, and - inhalation of groundwater. particulates.	• Potentially complete— evidence of domestic wells within or near AOC. • Exposure routes: - ingestion, - dermal contact, and - inhalation of water mist or vapor.	• Incomplete pathway, no ecological access to groundwater.	• Limited data (well in area).	• Collect groundwater sample from well within or near the AOC. Samples to be analyzed for explosives and metals.
				NO – Incomplete Pathway					
			Air • Not affected (non-volatile PCOCs)	Not Applicable (inhalation of particulates addressed via soil screening values).	Incomplete Pathway	Incomplete Pathway	Incomplete Pathway	None	None

Table 3 (continued)
MEC and MC Exposure Pathway Analysis – Explosive Munitions Range

Range Area & Type	MMRP Concern	Potential Contaminant of Concern (PCOCs)	Affected Media (Potential Contaminant Sources) (Fate and Transport)	PCOC Concentrations Exceed Screening Levels	Exposure Routes and Potential Receptors			Data Gaps	Activities to Address Data Gaps (i.e., Sampling)
					Site Workers/ Contractor Personnel	Residents/ General Public	Ecological (Livestock & Biota)		
Explosive Munitions Ranges	**MEC**	MEC in the form of ***unexploded*** military munitions used at this site.	**Surface & Subsurface Soils** • Unexploded munitions are a hazard.	Not Applicable	• Complete pathway (MEC found). • Exposure routes: - Vehicle traffic - Foot traffic - Intrusive activities - Geologic instability	• Complete pathway (MEC found). • Exposure routes: - Vehicle traffic - Foot traffic - Intrusive activity - Geologic instability	• Complete pathway (MEC found). • Exposure routes: - Foot traffic - Burrowing - Geologic instability	• None—Presence of MEC is known from previous MEC encounters.	Visual reconnaissance and localized magnetometer sweeps will be conducted to: • Practice MEC avoidance, and • Select appropriate sample locations.
	MC Explosives Metals		**Soil** • Incomplete detonation of explosive munitions.	**YES –** Complete or Potentially Complete Pathways → **NO –** Incomplete Pathway	• Potentially complete pathway. • Exposure routes (during intrusive work): - incidental ingestion, - dermal contact, and - inhalation of soil particulates.	• Potentially complete pathway. • Exposure routes (during intrusive work): - incidental ingestion, - dermal contact, and - inhalation of soil particulates.	• Potentially complete pathway but contact for most animals limited due to grass cover. • Exposure routes: - ingestion, and - direct contact by area fauna.	• Analytical data do not exist for Anti-Tank Range & Mortar Range.	• Composite soil samples will be analyzed for explosives and metals. Soil samples for metals will be sieved (#10 sieve) by the laboratory prior to analysis.
			Surface Water /Sediment • Potentially affected (streams). • Fate & Transport: via surface runoff from impacted soil.	**YES –** Complete or Potentially Complete Pathways → **NO –** Incomplete Pathway	• Potentially complete pathway. • Exposure routes: - incidental ingestion, - dermal contact, and - inhalation of surface water.	• Potentially complete pathway. • Exposure routes: - ingestion, - dermal contact, and - inhalation of water mist or vapor.	• Potentially complete pathway • Exposure routes: - ingestion, and - direct contact by area fauna.	• None	• Impact to surface water will be addressed by collection of a water sample from the Deschutes River down stream of the Mortar Range.
			Groundwater • Potentially affected media. • Fate & Transport: migration to groundwater via infiltration.	**YES –** Complete, Potentially Complete, or Incomplete Pathways → **NO –** Incomplete Pathway	• Potentially complete pathway. • Exposure routes (during intrusive work): - incidental ingestion, - dermal contact, and - inhalation of groundwater particulates.	• Incomplete pathway at Demolition Area and Mortar Range (hydraulic barrier between AOC and nearest wells). • Potentially complete at Anti-Tank Range (nearby domestic wells) • Exposure routes: - ingestion, - dermal contact, and - inhalation of water mist or vapor.	• Incomplete pathway for biota, no ecological access to groundwater. • Potentially complete pathway for livestock: - ingestion, - dermal contact, and - inhalation of water mist or vapor.	• Limited data (well in area).	• Impact to groundwater will be addressed via primarily affected medium – soil.
			Air • Not affected (non-volatile PCOCs)	NA (inhalation of particulates addressed via soil screening values).	Incomplete Pathway	Incomplete Pathway	Incomplete Pathway	None	None

Table 3 (continued)
MEC and MC Exposure Pathway Analysis –Grenade Courts

Range Area & Type	MMRP Concern	Potential Contaminant of Concern (PCOCs)	Affected Media (Potential Contaminant Sources) (Fate and Transport)	PCOC Concentrations Exceed Screening Levels	Exposure Routes and Potential Receptors			Data Gaps	Activities to Address Data Gaps (i.e., Sampling)
					Site Workers/ Contractor Personnel	Residents/ General Public	Ecological (Livestock & Biota)		
Grenade Courts	**MEC**	MEC in the form of ***unexploded*** grenades used at this site.	**Surface & Subsurface Soils** • Unexploded grenades are a hazard.	Not Applicable	• Potentially complete pathway. • Exposure routes: - Vehicle traffic - Foot traffic - Intrusive activity - Geologic instability	• Potentially complete pathway. • Exposure routes: - Vehicle traffic - Foot traffic - Intrusive activities - Geologic instability	• Potentially complete pathway. • Exposure routes: - Foot traffic - Burrowing - Geologic instability	• The extent of grenade training is uncertain.	Visual reconnaissance and localized magnetometer sweeps will be conducted to: • Assess evidence of munitions training activity in the area north of the mapped AOC, to the river junction. • Assess presence of MEC, • Practice MEC avoidance, and • Select sample locations, if evidence of munitions training activity is found in the expanded area.
	MC	Explosives Metals	**Soil** • Incomplete detonation of explosive munitions	**YES –** Complete or Potentially Complete Pathways →	• Potentially complete pathway. • Exposure routes (during intrusive work): - incidental ingestion, - dermal contact, and - inhalation of soil particulates.	• Potentially complete pathway. • Exposure routes (during intrusive work): - incidental ingestion, - dermal contact, and - inhalation of soil particulates.	• Potentially complete pathway. • Exposure routes: - ingestion, and - direct contact by area fauna.	• Analytical data may be required if evidence of munitions training activity is found beyond the previously investigated area.	• Potentially one or more composite soil samples, depending on reconnaissance, will be analyzed for explosives and metals.
				NO – Incomplete Pathway					
			Surface Water/Sediment • Potentially affected (streams). • Fate & Transport: via surface runoff from impacted soil.	**YES –** Complete or Potentially Complete Pathways →	• Potentially complete pathway. • Exposure routes: - incidental ingestion, - dermal contact, and - inhalation of surface water.	• Potentially complete pathway. • Exposure routes: - ingestion, - dermal contact, and - inhalation of water mist or vapor.	• Potentially complete pathway. • Exposure routes: - ingestion, and - direct contact by area fauna.	• Analytical data may be required if evidence of munitions training activity is found beyond the previously investigated area.	• Potentially one sediment sample, depending on reconnaissance, will be analyzed for explosives and metals.
				NO – Incomplete Pathway					
			Groundwater • Potentially affected media. • Fate & Transport: migration to groundwater via infiltration.	**YES –** Complete or Potentially Complete Pathways →	• Potentially complete pathway. • Exposure routes (during intrusive work): - incidental ingestion, - dermal contact, and - inhalation of groundwater. particulates.	• Potentially complete—nearby domestic wells. • Exposure - ingestion, - dermal contact, and - inhalation of water mist or vapor.	• Incomplete pathway, no ecological access to groundwater. • Potentially complete pathway for livestock: - ingestion, - dermal contact, and - inhalation of water mist or vapor.	• Limited data (well in area).	• Impact to groundwater will be addressed via primarily affected medium – soil.
				NO – Incomplete Pathway					
			Air • Not affected (non-volatile PCOCs)	Not Applicable (inhalation of particulates addressed via soil screening values).	Incomplete Pathway	Incomplete Pathway	Incomplete Pathway	None	None

Table 3 (continued)
MEC and MC Exposure Pathway Analysis – Burial Pit

Range Area & Type	MMRP Concern	Potential Contaminant of Concern (PCOCs)	Affected Media (Potential Contaminant Sources) (Fate and Transport)	PCOC Concentrations Exceed Screening Levels	Exposure Routes and Potential Receptors			Data Gaps	Activities to Address Data Gaps (i.e., Sampling)
					Site Workers/ Contractor Personnel	Residents/ General Public	Ecological (Livestock & Biota)		
Burial Pit	**MEC**	MEC in the form of ***unexploded*** munitions used at this site.	**Surface & Subsurface Soils** • Unexploded munitions are a hazard.	Not Applicable	• Potentially complete pathway. • Exposure routes: - Vehicle traffic - Foot traffic - Intrusive activity - Geologic instability	• Potentially complete pathway. • Exposure routes: - Vehicle traffic - Foot traffic - Intrusive activities - Geologic instability	• Potentially complete pathway. • Exposure routes: - Foot traffic - Burrowing - Geologic instability	• The specific location of the horseshoe shaped area, bermed and ringed with stone (the potential ordnance disposal pit) is uncertain.	Visual reconnaissance and localized magnetometer sweeps will be conducted to: • Identify the location of the horseshoe shaped area, • Assess presence of MEC, • Practice MEC avoidance, and • Select sample locations, if the location of the horseshoe shaped area is not where previous samples were collected.
	MC	Explosives Metals	**Soil** • Incomplete detonation of explosive munitions	**YES –** Complete or Potentially Complete Pathways → **NO –** Incomplete Pathway	• Potentially complete pathway. • Exposure routes (during intrusive work): - incidental ingestion, - dermal contact, and - inhalation of soil particulates.	• Potentially complete pathway. • Exposure routes (during intrusive work): - incidental ingestion, - dermal contact, and - inhalation of soil particulates.	• Potentially complete pathway. • Exposure routes: - ingestion, and - direct contact by area fauna.	• Analytical data may be required if evidence of munitions disposal is found beyond the previously investigated area.	• Potentially one or more surface and subsurface soil samples, depending on reconnaissance, will be analyzed for explosives and metals.
			Surface Water/Sediment • Potentially affected (streams, ponds). • Fate & Transport: via surface runoff from impacted soil.	**YES –** Complete or Potentially Complete Pathways → **NO –** Incomplete Pathway	• Potentially complete pathway. • Exposure routes: - incidental ingestion, - dermal contact, and - inhalation of surface water.	• Potentially complete pathway. • Exposure routes: - ingestion, - dermal contact, and - inhalation of water mist or vapor.	• Potentially complete pathway. • Exposure routes: - ingestion, and - direct contact by area fauna.	• Analytical data may be required if evidence of munitions disposal is found beyond the previously investigated area.	• Potentially one sediment sample, depending on reconnaissance, will be analyzed for explosives and metals.
			Groundwater • Potentially affected media. • Fate & Transport: migration to groundwater via infiltration.	**YES –** Complete or Potentially Complete Pathways → **NO –** Incomplete Pathway	• Potentially complete pathway. • Exposure routes (during intrusive work): - incidental ingestion, - dermal contact, and - inhalation of groundwater. particulates.	• Potentially complete—nearby domestic wells. • Exposure - ingestion, - dermal contact, and - inhalation of water mist or vapor.	• Incomplete pathway, no ecological access to groundwater. • Potentially complete pathway for livestock: - ingestion, - dermal contact, and - inhalation of water mist or vapor.	• Limited data (well in area).	• Collect one groundwater sample from a nearby well and analyzed for explosives and metals.
			Air • Not affected (non-volatile PCOCs)	Not Applicable (inhalation of particulates addressed via soil screening values).	Incomplete Pathway	Incomplete Pathway	Incomplete Pathway	None	None

Table 3 (continued)
MEC and MC Exposure Pathway Analysis – Chemical Training Area

Range Area & Type	MMRP Concern	Potential Contaminant of Concern (PCOCs)	Affected Media (Potential Contaminant Sources) (Fate and Transport)	PCOC Concentrations Exceed Screening Levels	Exposure Routes and Potential Receptors			Data Gaps	Activities to Address Data Gaps (i.e., Sampling)
					Site Workers/ Contractor Personnel	Residents/ General Public	Ecological		
Chemical Training Area	**MEC**	No indication of conventional munitions being used at this AOC. Small quantities of chemicals may have been used for training purposes.	**Surface & Subsurface Soils** • A mechanism by which chemical or conventional munitions would be present has not been identified.	Not Applicable	• Incomplete pathway.	• Incomplete pathway.	• Incomplete pathway.	None	None
	MC	Mustard, lewisite, and other chemicals may have been used for training purposes (identification kits).	**Soil** • Chemicals used in training would generally not persist in soil and/or would be of negligible quantity.	**NO –** Incomplete Pathway	Incomplete Pathway	Incomplete Pathway	Incomplete Pathway	None	None
			Surface Water • Unaffected per impact to soil described above.	**NO –** Incomplete Pathway	Incomplete Pathway	Incomplete Pathway	Incomplete Pathway	None	None
			Air • Unaffected per impact to soil described above.	**NO –** Incomplete Pathway	Incomplete Pathway	Incomplete Pathway	Incomplete Pathway	None	None

Table 4
Proposed Sampling Approach

No.	AOC	Number of Samples	Media to be Sampled				Contaminants of Concern			Comments
			Soil	Sediment	Ground-water	Surface Water	Lead*	Select Metals**	Explosives	
							Soil/Sed	Soil/Sed	Soil/Sed	
1	**Range Complex No. 1**	**7**	**4**	**2**	**1**		**7**	**--**	**1**	Samples at two subranges: Anti-Aircraft Range, Field Target/Sub-Machine Gun Range, Groundwater sample for nearby well (lead and explosives)
2	**Anti-Tank Range**	**1**	**1**	**--**			**--**	**1**	**1**	
3	**Demolition Area**	**0**	**--**	**--**			**--**	**--**	**--**	No samples required.
4	**Mortar Range**	**3**	**2**	**--**		**1**	**--**	**3**	**3**	Water and sediment sample collected downstream from range
5	**Grenade Courts**	**2**	**1**	**1**			**--**	**2**	**2**	Potential samples, depending on reconnaissance
6	**Burial Pit**	**4**	**2**	**1**	**1**		**--**	**4**	**4**	Potential samples, depending on reconnaissance
7	**Chemical Training Area**	**0**	**--**	**--**	**--**		**--**	**--**	**--**	No samples required.
Environmental		**17**	**10**	**4**	**2**	**1**	**7**	**10**	**11**	
Field Duplicate							1	1	1	Minimum 10% goal
Field Split							1	1	1	Minimum 10% goal
Matrix Spike (MS)							1	1	1	Minimum 5% goal (solids & water)
MS Duplicate							1	1	1	Minimum 5% goal, (solids & water)
Equipment Blank							N/A	N/A	0	To be determined per sampling methods
Material Blank							0	0	0	No reagents
Quality Control Samples							**4**	**4**	**4**	
Total Samples to be Analyzed							**11**	**14**	**15**	

AOC -- Areas of concern

Surface soil samples are composite samples (7-point, wheel pattern with 2-foot radius). All other samples are discrete grab samples.

In addition to the QC samples shown above, temperature blanks will be submitted with samples; one blank per cooler.

Lead and metals by SW-846 6020A. Explosives by SW-846 8330A/Modified 8330A.

* Analyses for lead will be performed on soil or sediment that has been passed through an ASTM No. 10 (2-mm) wire mesh sieve at the laboratory.

** Select metals are: aluminium, barium, cadmium, chromium, cobalt, copper, iron, lead, manganese, magnesium, molybdenum, and zinc.

Table 5
Human Health Screening Criteria for Soil/Sediment at Oregon Sites

Analyte	Abbreviation	CAS No.	Region 9 Human Health Screening Values			
			Residential PRG[b] (mg/kg)[b]	Industrial PRG[b] (mg/kg)	SSLs[c] DAF=1 (mg/kg)	SSLs[c] DAF=20 (mg/kg)
Aluminum	Al	7429-90-5	76,000	100,000		
Barium	Ba	7440-38-2	5,400	67,000	82	1,600
Cadmium	Cd	7440-43-9	37	450	0.4	8
Chromium[h]	Cr	7440-47-3	210	450	2	38
Cobalt	Co	7440-48-4	900	1,900		
Copper	Cu	7440-50-8	3,100	41,000		
Iron	Fe	7439-89-6	23,000	100,000		
Lead	Pb	7439-92-1	30/400[j]	750/800[j]		
Manganese	Mn	7439-96-5	1,800	19,000		
Magnesium	Mg	7439-95-4				
Molybdenum	Mo	7439-98-7	390	5,100		
Nickel	Ni	7440-02-0	1,600	20,000	7	130
Zinc	Zn	7440-66-6	23,000	100,000	620	12,000
Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	121-82-4	4.4	16		
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	2691-41-0	3,100	31,000		
2,4,6-Trinitrotoluene	2,4,6-TNT	118-96-7	16	57		
1,3,5-Trinitrobenzene	1,3,5-TNB	99-35-4	1,800	18,000		
1,3-Dinitrobenzene	1,3-DNB	99-65-0	6.1	62		
2,4-Dinitrotoluene[g]	2,4-DNT	121-14-2	0.72	2.5	0.00004	0.0008
2,6-Dinitrotoluene[g]	2,6-DNT	606-20-2	0.72	2.5	0.00004	0.0008
2-Amino-4,6-dinitrotoluene	2-Am-DNT	35572-78-2	12	120		
2-Nitrotoluene	2-NT	88-72-2	0.88	2.2		
3-Nitrotoluene	3-NT	99-08-1	730	1,000		
4-Amino-2,6-dinitrotoluene	4-Am-DNT	19406-51-0	12	120		
4-Nitrotoluene	4-NT	99-99-0	12	30		
Nitrobenzene	NB	98-05-3	20	100	0.007	0.1
Methyl-2,4,6-trinitrophenylnitramine	Tetryl	479-45-8	610	6,200		

DAF = Dilution Attenuation Factor.
PRG = Preliminary Remediation Goal.
SSL = Soil Screening Level.
mg/kg = milligrams per kilogram.
mg/L = milligrams per liter.

a If laboratory cannot meet any of the preferred QLs with routine SW 846 methodology (as supported by MDLs that are no greater than 1/3 QL), laboratory's QL must be identified in laboratory submittal as failing to meet the QL. Some screening values cannot be obtained with routine methodology to the QL. In those cases, the QL achievable with a routine SW 846 methodology would be accepted.

b PRGs from Region 9 PRG Table dated October 2004 and addendum dated 28 December 2004, based on single chemical.

c SSLs from Region 9 PRG Table dated October 2004 and revision note dated 28 December 2004.

d Soil cleanup levels from Oregon DEQ Hazardous Substance Remedial Action Rules, dated 27 July 2000. OAR 340-122-045(1) through (5), Table 1.

e Concentrations from Oregon DEQ Hazardous Substance Remedial Action Rules, dated 27 July 2000. OAR 340-122-045(7), Appendix 1.

f Concentrations from Oregon DEQ Hazardous Substance Remedial Action Rules, dated 27 July 2000. OAR 340-122-045(6)(a), Appendix 1. f Concentrations from Oregon DEQ Hazardous Substance Remedial Action Rules, dated 27 July 2000. OAR 340-122-045(6)(a), Appendix 1

g Carconogenic DNT mixture values used if more conservative than noncarcinogenic isomer-specific values.

h Total chromium values used.

i Based on PRG for pyrene as a surrogate value.

j Values listed for lead include Oregon risk-based concentrations: 30 mg/kg (leaching to groundwater), 400 mg/kg (residential), and 750 mg/kg (occupational/construction worker/excavation worker_

Table 6
Human Health Screening Criteria for Groundwater at Oregon Sites

			Region 9 Tap Water PRG[b] (µg/L)	Federal Drinking Water Criteria MCLs[c] (mg/L)	Oregon DEQ Numerical Groundwater Quality Reference Levels[d] (µg/L)
Hexahydro-1,3,5-trinitro-1,3,5-triazine	RDX	121-82-4	0.61		
Octahydro-1,3,5,7-tetranitro-1,3,5,7-tetrazocine	HMX	2691-41-0	1,800		
2,4,6-Trinitrotoluene	2,4,6-TNT	118-96-7	2.2		
1,3,5-Trinitrobenzene	1,3,5-TNB	99-35-4	1,100		
1,3-Dinitrobenzene	1,3-DNB	99-65-0	3.6		
2,4-Dinitrotoluene[e]	2,4-DNT	121-14-2	0.099		
2,6-Dinitrotoluene[e]	2,6-DNT	606-20-2	0.099		
2-Amino-4,6-dinitrotoluene	2-Am-DNT	35572-78-2	7.3		
2-Nitrotoluene	2-NT	88-72-2	0.049		
3-Nitrotoluene	3-NT	99-08-1	120		
4-Amino-2,6-dinitrotoluene	4-Am-DNT	19406-51-0	7.3		
4-Nitrotoluene	4-NT	99-99-0	0.66		
Nitrobenzene	NB	98-05-3	3.4		
Methyl-2,4,6-trinitrophenylnitramine	Tetryl	479-45-8	360		
Aluminum	Al	7429-90-5	36,000	50[f]	
Barium	Ba	7440-38-2	2,600	2,000	1,000
Cadmium	Cd	7440-43-9	18	5	10
Chromium[f]	Cr	7440-47-3	110	100	50
Cobalt	Co	7440-48-4	730		
Copper	Cu	7440-50-8	1,500	1,000[f] 1,300[h]	1,000[i]
Iron	Fe	7439-89-6	11,000	300[f]	300[i]
Lead	Pb	7439-92-1		15[h]	50
Magnesium	Mg	7439-95-4			
Manganese	Mn	7439-96-5	880	50[f]	50[i]
Molybdenum	Mo	7439-98-7	180		
Nickel	Ni	7440-02-0	730		
Zinc	Zn	7440-66-6	11,000	5,000f	5,000i

Table 6 (Cont.)
Human Health Screening Criteria for Groundwater at Oregon Sites

MCL = Maximum Contaminant Level
PRG = Preliminary Remediation Goal
mg/L = micrograms per liter

a If laboratory cannot meet these QLs with routine SW 846 methodology (as supported by MDLs that are no greater than 1/3 QL), laboratory's QL must be identified in laboratory submittal as failing to meet the QL. Some screening values cannot be obtained with routine methodology to the QL.
Note that no surface water samples are planned at this time. If surface water is collected, additional human health screening criteria will be compiled.
b Region 9 PRG Table dated October 2004 and revision note dated 28 December 2004, based on single chemical.
c Primary MCL from the 2004 Edition of the Drinking Water Standards and Health Advisories, dated Winter 2004, is listed unless otherwise indicated.
d Values from OAR 340-40-020, Table 1, dated November 1997.
e Carcinogenic DNT mixture values used if more conservative than noncarcinogenic isomer-specific values.
f Secondary MCL from the 2004 Edition of the Drinking Water Standards and Health Advisories, dated Winter 2004.
g Total chromium values used if available.
h Action level from the 2004 Edition of the Drinking Water Standards and Health Advisories, dated Winter 2004.
i Numerical Groundwater Quality Guidance Level from OAR 340-40-020, Table 3, dated November 1997.
j Value from the 2004 Edition of the Drinking Water Standards and Health Advisories, dated Winter 2004, Drinking Water Advisory Table.

Table 7
Selection of Ecological Soil Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

Parameter	ODEQ Level II Screening Level [a] Lowest Value for Plants/Inverts./ Birds/Mammals (mg/kg)	Proposed Benchmarks							Other Values: Talmage et al. (1999) [f] or LANL (2005) [g] (mg/kg)		Potential Bio accumulative Constituent? [h]	Final Ecological Screening Value Soil [i] (mg/kg)	Practical Quantitation Limit (mg/kg)
		Region 5 ESLs [b] (2003) (mg/kg)	Region 7 [c] (mg/kg)		Region 8 [d] (mg/kg)		Region 10 [e] (mg/kg)						
Metals/Inorganics													
Aluminum	50	NVA	50	EPA-R4	NVA		50	EPA-R4	5.5	LANL		50	20.0
Barium	85	1.04	330	SSL	330	SSL	330	SSL	110	LANL		85	0.5
Cadmium	4	0.00222	0.36	SSL	0.36	SSL	0.36	SSL	0.27	LANL	Yes	4	0.5
Chromium (total)	0.4	0.4	26	SSL	26	SSL	26	SSL	2.3	LANL	Yes	0.4	1.0
Cobalt	20	0.14	13	SSL	13	SSL	13	SSL	13	LANL		20	0.5
Copper	50	5.4	60	ORNL	190	Dutch	60	ORNL	10	LANL	Yes	50	1.0
Iron	10	NVA	200	EPA-R4	NVA		200	EPA-R4	NVA			10	15.0
Lead	16	0.0537	11	SSL	11	SSL	11	SSL	14	LANL	Yes	16	1.0
Magnesium	NVA	NVA	440000	EPA-R4	NVA		440000	EPA-R4	NVA			NVA/Nutrient	25.0
Manganese	100	NVA	100	EPA-R4	NVA		100	EPA-R4	50	LANL		100	0.5
Molybdenum	2	NVA	2	ORNL	2	ORNL	2	ORNL	NVA			2	0.5
Nickel	30	13.6	30	ORNL	30	ORNL	30	ORNL	20	LANL	Yes	30	1.0
Zinc	50	6.62	8.5	ORNL	8.5	ORNL	8.5	ORNL	10	LANL	Yes	50	2.0

Table 7 (Cont.)
Selection of Ecological Soil Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

Parameter	ODEQ Level II Screening Level [a] Lowest Value for Plants/Inverts./ Birds/Mammals (mg/kg)	Proposed Benchmarks							Other Values: Talmage et al. (1999) [f] or LANL (2005) [g] (mg/kg)		Potential Bio accumulative Constituent? [h]	Final Ecological Screening Value Soil [i] (mg/kg)	Practical Quantitation Limit (mg/kg)
		Region 5 ESLs [b] (2003) (mg/kg)	Region 7 [c] (mg/kg)		Region 8 [d] (mg/kg)		Region 10 [e] (mg/kg)						
Explosive													
2,4-Dinitrotoluene	NVA	1.28	1.28	EPA-R4	NVA		1.28	EPA-R4	0.52	LANL		1.28	0.040
2,6-Dinitrotoluene	NVA	0.0328	0.0328	EPA-R4	NVA		0.0328	EPA-R4	0.37	LANL		0.0328	0.040
2-Amino-4,6-Dinitrotoluene	NVA	NVA	NVA		NVA		NVA		2.1	LANL		2.1	0.040
4-Amino-2,6-Dinitrotoluene	NVA	NVA	NVA		NVA		NVA		0.73	LANL		0.73	0.040
1,3-Dinitrobenzene	NVA	0.655	0.655	EPA-R4	NVA		0.655	EPA-R4	0.073	LANL		0.655	0.020
HMX	NVA	NVA	NVA		NVA		NVA		27	LANL		27	0.050
Nitrobenzene	8	1.31	1.31	EPA-R4	NVA		1.31	EPA-R4	2.2	LANL		8	0.020
RDX	NVA	NVA	NVA		NVA		NVA		7.5	LANL		7.5	0.075
1,3,5-Trinitrobenzene	NVA	0.376	0.376	EPA-R4	NVA		0.376	EPA-R4	6.6	LANL		0.376	0.020
2,4,6-Trinitrotoluene	NVA	NVA	NVA		NVA		NVA		6.4	LANL		6.4	0.040
2-Nitrotoluene	NVA	NVA	NVA		NVA		NVA		2.0	LANL		2.0	0.075
3-Nitrotoluene	NVA	NVA	NVA		NVA		NVA		2.4	LANL		2.4	0.050
4-Nitrotoluene	NVA	NVA	NVA		NVA		NVA		4.4	LANL		4.4	0.040
Tetryl	NVA	NVA	NVA		NVA		NVA		0.99	LANL		0.99	0.065

NVA: No value available

Table 7 (Cont.)
Selection of Ecological Soil Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

a Oregon Department of Environmental Quality Screening Level Values (December 2001).
b Ecological Screening Levels (ESLs), U.S.EPA Region V, August 2003.
c USEPA Region 7: Catherine Wooster-Brown (Eco Risk Assessor) recommends the following hierarchy: USEPA EcoSSLs; ORNL Effroymson values; USEPA Region 4 values; other published values.
d USEPA Region 8: Dale Hoff (Eco Risk Assessor) recommends the following hierarchy: USEPA SSLs; Dutch Intervention Values or ORNL Effroymson values.
e USEPA Region 10: Joseph Goulet (Eco Risk Assessor) says Region 10 has no recommended hierarchy, therefore, values from the USEPA Region 7 Approach were used.
f Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E. Welsh, F.M. Cretella, P.H. Reno, and F.B. Daniel, 1999, Nitroaromatic Munition Compounds: Environmental Effects and Screening Values,

'Rev. Environ. Contam. Toxicol.
g Los Alamos National Laboratory (LANL), Eco Risk Database, Release 2.2, September 2005.
h Potential bioaccumulative constituents will be evaluated in more detail, as some screening values do not take into account bioaccumulation.
Potential bioaccumulative potential from: Bioaccumulation and Interpretation for the Purposes of Sediment Quality Assessment: Status and Needs (USEPA, 2000) and ODEQ EQSLVs (ODEQ, 2001).
i Final Screening Value selected using the following hierarchy:

1. State Value (Oregon)
2. USEPA Region State Located In (USEPA Region 10)
3. Lower of Talmage et al. (1999) or LANL (2005) values.

EPA-R4=USEPA Region 4
LANL= Los Alamos National Laboratory
SSL=USEPA Eco Soil Screening Levels
Dutch=Dutch Intervention Values
ORNL= Oak Ridge National Laboratory Ecological PRGs (Efroymson et al)

Other References:

U.S. Environmental Protection Agency, 2005, Guidance for Developing Ecological Soil Screening Levels (Eco-SSLs), Office of Solid Waste and Emergency Response, website version last updated March 15, 2005: http://www.epa.gov/ecotox/ecossl.
U.S. Environmental Protection Agency, 2001, Supplemental Guidance to RAGS: Region 4 Bulletins, Ecological Risk Assessment. Originally published November 1995. Website version last updated November 30, 2001: http://www.epa.gov/region4/waste/ots/ecolbul.htm.
Efroymson, R.A., Suter II, G.W., Sample, B.E. and Jones, D.S., 1997. Preliminary Remediation Goals for Ecological Endpoints. Lockheed Martin Energy Systems, Inc. (ORNL) ES/ER/TM-162/R2.
Dutch Intervention Values:
Swartjes, F.A. 1999. Risk-based Assessment of Soil and Groundwater Quality in the Netherlands: Standards and Remediation Urgency. Risk Analysis 19(6): 1235-1249
The Netherlands Ministry of Housing, Spatial Planning and Environment's Circular on target values and intervention values for soil remediation http://www2.minvrom.nl/Docs/internationaal/S_I2000.pdf and Annex A:
Target Values, Soil Remediation Intervention Values and Indicative Levels for Serious Contamination http://www2.minvrom.nl/Docs/internationaal/annexS_I2000.pdf were also consulted.

Table 8
Selection of Ecological Surface Water Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

Parameter	ODEQ Screening Level Values[a] (mg/L) Freshwater	Region 5 Ecological Screening Levels[b] (mg/L)	EPA Region 7 [c] (mg/L)		EPA Region 8 [d] (mg/L)		EPA Region 10 [e] (mg/L)		Other Ecological Screening Values[f] (mg/L)		Potential Bioaccumulative Constituent?[g]	Final Ecological Value Surface Water [h] (mg/L)	Practical Quantitation Limit (mg/L)
Metals/Inorganics													
Aluminum	8.70E-02	NVA	8.70E-02	AWQC	8.70E-02	AWQC	8.70E-02	AWQC	8.70E-02	LANL		8.70E-02	6.0E-02
Barium	4.00E-03	2.20E-01	4.00E-03	EPRG	4.00E-03	Tier II	4.00E-03	EPRG	3.80E-03	LANL		4.00E-03	5.0E-03
Cadmium	2.20E-03	1.50E-04	2.50E-04	AWQC	2.50E-04	AWQC	2.50E-04	AWQC	1.50E-04	LANL	Yes	2.20E-03	5.0E-04
Chromium (Cr-III)	7.40E-02	4.20E-02	7.40E-02	AWQC	7.40E-02	AWQC	7.40E-02	AWQC	7.70E-02	LANL	Yes	7.40E-02	2.0E-03
Cobalt	2.30E-02	2.40E-02	2.30E-02	EPRG	2.30E-02	Tier II	2.30E-02	EPRG	3.00E-03	LANL		2.30E-02	1.0E-03
Copper	9.00E-03	1.58E-03	9.00E-03	AWQC	9.00E-03	AWQC	9.00E-03	AWQC	5.00E-03	LANL	Yes	9.00E-03	3.0E-03
Iron	1.00E+00	NVA	1.00E+00	AWQC	1.00E+00	AWQC	1.00E+00	AWQC	1.00E+00	LANL		1.00E+00	5.0E-02
Lead	2.50E-03	1.17E-03	2.50E-03	AWQC	2.50E-03	AWQC	2.50E-03	AWQC	1.20E-03	LANL	Yes	2.50E-03	1.0E-03
Magnesium	8.20E+01	NVA	NVA		NVA		NVA		NVA			8.20E+01	1.0E-01
Manganese	1.20E-01	NVA	1.20E-01	EPRG	1.20E-01	Tier II	1.20E-01	EPRG	8.00E-02	LANL		1.20E-01	2.0E-03
Mercury	7.70E-04	1.30E-06	7.70E-01	AWQC	7.70E-01	AWQC	7.70E-01	AWQC	7.70E-04	LANL	Yes	7.70E-04	3.0E-04
Molybdenum	3.70E-01	NVA	3.70E-01	EPRG	3.70E-01	Tier II	3.70E-01	EPRG	NVA			3.70E-01	5.0E-03
Nickel	5.20E-02	2.89E-02	5.20E-02	AWQC	5.20E-02	AWQC	5.20E-02	AWQC	2.80E-02	LANL	Yes	5.20E-02	1.0E-03
Zinc	1.20E-01	6.57E-02	1.20E-01	AWQC	1.20E-01	AWQC	1.20E-01	AWQC	6.60E-02	LANL	Yes	1.20E-01	1.0E-02

Table 8 (Cont.)
Selection of Ecological Surface Water Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

Parameter	ODEQ Screening Level Values[a] (mg/L) Freshwater	Region 5 Ecological Screening Levels[b] (mg/L)	EPA Region 7 [c] (mg/L)		EPA Region 8 [d] (mg/L)		EPA Region 10 [e] (mg/L)		Other Ecological Screening Values[f] (mg/L)		Potential Bioaccumulative Constituent?[g]	Final Ecological Value Surface Water [h] (mg/L)	Practical Quantitation Limit (mg/L)
Explosives													
RDX	NVA	NVA	NVA		NVA		NVA		1.90E-01	TAL		1.90E-01	8.0E-04
HMX	NVA	NVA	NVA		NVA		NVA		3.30E-01	TAL		3.30E-01	4.0E-04
1,3-Dinitrobenzene	NVA	2.20E-02	NVA		NVA		NVA		2.00E-02	TAL		2.00E-02	2.0E-04
1,3,5-Trinitrobenzene	NVA	NVA	NVA		NVA		NVA		1.00E-02	TAL		1.00E-02	2.0E-04
2-Nitrotoluene	NVA	NVA	NVA		NVA		NVA		8.00E+00	LANL		8.00E+00	4.0E-04
3-Nitrotoluene	NVA	NVA	NVA		NVA		NVA		9.60E+00	LANL		9.60E+00	8.0E-04
4-Nitrotoluene	NVA	NVA	NVA		NVA		NVA		1.70E+01	LANL		1.70E+01	4.0E-04
2,4-Dinitrotoluene	2.30E-01	4.40E-02	NVA		NVA		NVA		3.10E-01	LANL		2.30E-01	3.0E-04
2,6-Dinitrotoluene	2.30E-01	8.10E-02	NVA		NVA		NVA		6.00E-02	LANL		2.30E-01	3.0E-04
2-Amino,4,6-Dinitrotoluene	NVA	NVA	NVA		NVA		NVA		2.00E-02	TAL		2.00E-02	2.0E-04
4-Amino-2,6-Dinitrotoluene	NVA	NVA	NVA		NVA		NVA		8.60E+00	LANL		8.60E+00	2.0E-04
2,4,6-Trinitrotoluene	NVA	NVA	NVA		NVA		NVA		9.00E-02	TAL		9.00E-02	3.0E-04
Nitrobenzene	5.40E-01	2.20E-01	NVA		NVA		NVA		2.70E-01	LANL		5.40E-01	2.0E-04
Tetryl	NVA	NVA	NVA		NVA		NVA		5.80E+00	LANL		5.80E+00	7.5E-04

NVA = No Value Available

Table 8 (Cont.)
Selection of Ecological Surface Water Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

a Oregon Department of Environmental Quality Screening Level Values (December 2001).
b Ecological Screening Levels (ESLs), U.S.EPA Region 5, August 2003.
c USEPA Region 7: Catherine Wooster-Brown (Eco Risk Assessor) recommends the following hierarchy: National Ambient Water Quality Criteria; ORNL Effroymson values (ORNL, 1977).
d USEPA Region 8: Dale Hoff (Eco Risk Assessor) recommends the following hierarchy: National Ambient Water Quality Criteria; Great Lakes Tier II Values;
Canadian Environmental Quality Guidelines (CCME, 2003) or ORNL Effroymson values (ORNL, 1977).
e USEPA Region 10: Joseph Goulet (Eco Risk Assessor) says Region 10 has no recommended hierarchy, therefore, values from the USEPA Region 7 Approach were used.
f Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E. Welsh, F.M. Cretella, P.H. Reno, and F.B. Daniel (TAL), 1999, Nitroaromatic Munition Compounds: Environmental Effects and Screening Values.

Rev. Environ. Contam. Toxicol.
Los Alamos National Laboratory (LANL), Eco Risk Database, Release 2.2, September 2005**.**
g Potential bioaccumulative constituents will be evaluated in more detail, as some screening values do not take into account bioaccumulation.
Potential bioaccumulative potential from: Bioaccumulation and Interpretation for the Purposes of Sediment Quality Assessment: Status and Needs (USEPA, 2000) and ODEQ EQSLVs (ODEQ, 2001).
h Final Screening Value selected using the following hierarchy:
1. State Value (Oregon)
2. USEPA Region State Located In (USEPA Region 10)
3. Lower of Talmage et al. [TAL] (1999) or LANL (2005) values.

AWQC=National Ambient Water Quality Criteria
LANL= Los Alamos National Laboratory
Tier II=Great Lakes Tier II Water Quality Criteria
EPRGs=Oak Ridge National Laboratory Ecological PRGs
TAL=Talmage et al (1999)
CCME=Canadian Council of Ministers of the Environment, Environmental Quality Guidelines

Other References:
Efroymson, R.A., et al., 1997, Preliminary Remediation Goals (EPRGs), ORNL, ES/ER/TM-162/R2,
Canadian Environmental Quality Guidelines (for Freshwater) Summary Table, CCME, December 2003.
Great Lakes Tier II Values from Suter, G.W. and C.L. Tsao, 1996, Toxicological Benchmarks for Screening Potential Contaminants of Concern for Effects on Aquatic Biota: 1996 Rev, ES/ER/TM-96/R2.
National AWQC from USEPA Water Quality Criteria Web Site: http://www.epa.gov/waterscience/criteria/wqcriteria.html .

Table 9
Selection of Ecological Sediment Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

Parameter	ODEQ Screening Level Values [a] (mg/kg) Freshwater	Region 5 Ecological Screening Levels [b] (mg/kg)	EPA Region 7 [c] (mg/kg)		EPA Region 8 [d] (mg/kg)		EPA Region 10 [e] (mg/kg)		Other Ecological Screening Levels [f] (mg/kg)		Potential Bioaccumulative Constituent? [g]	Final Ecological Screening Value Sediment [h] (mg/kg)	Practical Quantitation Limit (mg/kg)
Metals/Inorganics													
Aluminum	NVA	NVA	NVA		NVA		NVA		2.80E+02	LANL		2.80E+02	20.0
Barium	NVA	NVA	NVA		NVA		NVA		4.80E+01	LANL		4.80E+01	0.5
Cadmium	3.00E-03	9.90E-01	9.90E-01	MAC	9.90E-01	MAC	9.90E-01	MAC	3.30E-01	LANL	Yes	3.00E-03	0.5
Chromium	3.70E+01	4.34E+01	4.34E+01	MAC	4.34E+01	MAC	4.34E+01	MAC	5.60E+01	LANL	Yes	3.70E+01	1.0
Cobalt	NVA	5.00E+01	NVA		NVA		NVA		2.30E+02	LANL		2.30E+02	0.5
Copper	1.00E+01	3.16E+01	3.16E+01	MAC	3.16E+01	MAC	3.16E+01	MAC	1.70E+01	LANL	Yes	1.00E+01	1.0
Iron	NVA	NVA	NVA		NVA		NVA		2.00E+01	LANL		2.00E+01	15.0
Lead	3.50E+01	3.58E+01	3.58E+01	MAC	3.58E+01	MAC	3.58E+01	MAC	2.70E+01	LANL	Yes	3.50E+01	1.0
Magnesium	NVA	NVA	NVA		NVA		NVA		NVA			NVA	25.0
Manganese	1.10E+03	NVA	NVA		NVA		NVA		7.20E+02	LANL		1.10E+03	0.5
Molybdenum	NVA	NVA	NVA		NVA		NVA		NVA			NVA	0.5
Nickel	1.80E+01	2.27E+01	2.27E+01	MAC	2.27E+01	MAC	2.27E+01	MAC	3.90E+01	LANL	Yes	1.80E+01	1.0
Zinc	3.00E+00	1.21E+02	1.21E+02	MAC	1.21E+02	MAC	1.21E+02	MAC	3.70E+01	LANL	Yes	3.00E+00	2.0

Table 9 (Cont.)
Selection of Ecological Sediment Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

Parameter	ODEQ Screening Level Values [a] (mg/kg) Freshwater	Region 5 Ecological Screening Levels [b] (mg/kg)	EPA Region 7 [c] (mg/kg)		EPA Region 8 [d] (mg/kg)		EPA Region 10 [e] (mg/kg)		Other Ecological Screening Levels [f] (mg/kg)		Potential Bioaccumulative Constituent? [g]	Final Ecological Screening Value Sediment [h] (mg/kg)	Practical Quantitation Limit (mg/kg)
Explosives													
RDX	NVA	NVA	NVA		NVA		NVA		1.30E-01	TAL		1.30E-01	0.075
HMX	NVA	NVA	NVA		NVA		NVA		4.70E-02	TAL		4.70E-02	0.050
1,3,5-Trinitrobenzene	NVA	NVA	NVA		NVA		NVA		2.40E-02	TAL		2.40E-02	0.020
1,3-Dinitrobenzene	NVA	8.61E-03	NVA		NVA		NVA		6.70E-02	TAL		6.70E-02	0.020
2,4-Dinitrotoluene	NVA	1.44E-03	NVA		NVA		NVA		2.90E-01	LANL		2.90E-01	0.040
2,6-Dinitrotoluene	NVA	3.98E-03	NVA		NVA		NVA		1.90E+00	LANL		1.90E+00	0.040
2,4,6-TNT	NVA	NVA	NVA		NVA		NVA		9.20E-01	TAL		9.20E-01	0.040
2-Amino-4,6,-Dintrotoluene	NVA	NVA	NVA		NVA		NVA		7.00E+00	LANL		7.00E+00	0.040
4-Amino-2,6,-Dintrotoluene	NVA	NVA	NVA		NVA		NVA		1.90E+00	LANL		1.90E+00	0.040
2-Nitrotoluene	NVA	NVA	NVA		NVA		NVA		5.60E+00	LANL		5.60E+00	0.075
3-Nitrotoluene	NVA	NVA	NVA		NVA		NVA		4.90E+00	LANL		4.90E+00	0.050
4-Nitrotoluene	NVA	NVA	NVA		NVA		NVA		1.00E+01	LANL		1.00E+01	0.040
Nitrobenzene	NVA	1.45E-01	NVA		NVA		NVA		3.20E+01	LANL		3.20E+01	0.020
Tetryl	NVA	NVA	NVA		NVA		NVA		1.00E+02	LANL		1.00E+02	0.065

NVA = No Value Available

Table 9 (Cont.)
Selection of Ecological Sediment Screening Toxicity Values for Constituents of Potential Ecological Concern (Oregon Sites)

a Oregon Department of Environmental Quality Screening Level Values (December 2001).
b Ecological Screening Levels (ESLs), U.S.EPA Region V, August 2003.
c USEPA Region 7: Catherine Wooster-Brown (Eco Risk Assessor) recommends the following hierarchy: MacDonald Consensus Values (MacDonald, 2000); ORNL Effroymson values (ORNL, 1977).
d USEPA Region 8: Dale Hoff (Eco Risk Assessor) recommends the following hierarchy: MacDonald Consensus Values (MacDonald, 2000); Canadian ISQG values (CCME, 2003) or ORNL Effroymson values (ORNL, 1977).
e USEPA Region 10: Joseph Goulet (Eco Risk Assessor) says Region 10 has no recommended hierarchy, therefore, values from the USEPA Region 7 Approach were used.
f Talmage, S.S., D.M. Opresko, C.J. Maxwell, C.J.E. Welsh, F.M. Cretella, P.H. Reno, and F.B. Daniel (TAL), 1999, Nitroaromatic Munition Compounds: Environmental Effects and Screening Values,

Rev. Environ. Contam. Toxicol. or Los Alamos National Laboratory (LANL), Eco Risk Database, Release 2.2, September 2005.
g Potential bioaccumulative constituents will be evaluated in more detail, as some screening values do not take into account bioaccumulation.
Potential bioaccumulative potential from: Bioaccumulation and Interpretation for the Purposes of Sediment Quality Assessment: Status and Needs (USEPA, 2000) and ODEQ EQSLVs (ODEQ, 2001).
h Final Screening Value selected using the following hierarchy:
1. State Value (Oregon)
2. USEPA Region State Located In (USEPA Region 10)
3. Lower of Talmage et al. [TAL] (1999) or LANL (2005) values.

Note: The Talmage [TAL] screening values assume 10% organic carbon in the sediment.

MAC=MacDonald Consensus Values
EPRGs=Oak Ridge National Laboratory Ecological PRGs
ISQGs=Canadian Interim Sediment Quality Guidelines
LALN=Los Alamos National Laboratory
TAL=Talmage et al (1999)

Other References:
Efroymson, R.A., et al., 1997, Preliminary Remediation Goals (EPRGs), ORNL, ES/ER/TM-162/R2,
Canadian Interim Sediment Quality Guidelines (ISQGs) Summary Table, CCME, December 2003.
MacDonald, D.D, C.G. Ingersoll and T.A. Berger, 2000, Development and Evaluation of Consensus-Based Sediment Quality Criteria for Freshwater Ecosystems, Archives of Environmental Contamination and Toxicology 39:20-31.

Draft Worksheets

Site Information Worksheet
MRSPP Data Gaps
HRS Data Gaps

Site Inspection
Camp Abbot

Technical Project Planning Meeting
April 4, 2006

Site Information Worksheet

Site: 7 AOCs

Project: Camp Abbot

	Site Information Needed[a]	Suggested Means to Obtain Site Information	Potential Source(s) of Site Information	Responsible for Obtaining	Deadline for Obtaining Site Information
1	Appropriate analytical parameters and methods	TPP stakeholder concurrence		Stakeholders	For inclusion in TPP Memo
2	Health and ecological screening values	TPP stakeholder concurrence		Stakeholders	For inclusion in TPP Memo
3	SI approach to surface water and groundwater pathways	TPP stakeholder concurrence		Stakeholders	For inclusion in TPP Memo
4	Assault/demolition range (from Demolition Area & Mortar Range)	TPP stakeholder concurrence		Stakeholders	For inclusion in TPP Memo
5	AOC locations & boundaries	Review of aerial photographs	Aerial photographs (1940's-1950's)	Shaw & USACE	For inclusion in SSWP
6	Background metals data	Review and/or sample	Published literature, USGS, sampling	Shaw	For inclusion in SSWP
7	Background sampling requirements for metals	ODEQ protocol	ODEQ guidance document	ODEQ	For inclusion in TPP Memo
8	Schedule for sampling AOCs	Consultation	ODEQ	Shaw	Prior to field work
9	Inform landowners of site visits	Phone			Prior to field work
10	Lat/Long and x,y on all maps	GIS	Add to maps	Shaw	For inclusion in TPP Memo
11	Point of contact for community	Not applicable			Before start of field work
12	Access agreements	Letters, call, or visit stakeholders	Letters/conversations with stakeholders	USACE	Before start of field work
13	Threatened or endangered species within AOCs	Phone	U.S. Fish and Wildlife	Shaw	For inclusion in TPP Memo
14	Areas of cultural significance within AOCs	SHPO	Phone SHPO	Shaw	For inclusion in TPP Memo
15	History of landfill use	Literature review	Army & community records	Shaw	For inclusion in SSWP

[a] Refer to EM 200-1-2, Paragraphs 1.1.3 and 2.2.

Munitions Response Site Prioritization Protocol (MRSPP) Data Gaps
32 CRF Part 179

Installation: **Camp Abbot**
AOC: **Range Complex No. 1**
RMIS Range ID: **F10OR0041**

Module	Table No.	Table Description	Data Gap	Potential Source of Information to Fill Data Gap	No Data Gap	Description of Known Data
Explosive Hazard Evaluation (EHE)	1	Munitions Type	x	Reconnaissance of area		Small arms (.22 to .50 caliber)
	2	Source of Hazard			x	Former small arms range
	3	Location of Munitions			x	Suspected historical evidence
	4	Ease of Access			x	No barrier
	5	Status of Property			x	Non-DoD control
	6	Population Density			x	< 100 persons per square mile
	7	Population Near Hazard	x	0 inhabited structures w/in 2 miles		
	8	Activities/Structures			x	Agricultural - livestock grazing
	9	Ecological and/or Cultural Resources	x	State Historical Preservation Office		
	10	**EHE Module Score**	**x**	**Evaluation pending filling of data gaps**		
Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)	11	CWM Configuration			x	Historical evidence indicates that CWM are not present
	12	Sources of CWM			x	Historical evidence indicates that CWM are not present
	13	Location of CWM			x	Historical evidence indicates that CWM are not present
	14	Ease of Access			x	No barrier
	15	Status of Property			x	Non-DoD control
	16	Population Density			x	< 100 persons per square mile
	17	Population Near Hazard	x	0 inhabited structures w/in 2 miles		
	18	Activities/Structures			x	Agricultural - livestock grazing
	19	Ecological and/or Cultural Resources	x	State Historical Preservation Office		
	20	**CHE Module Score**	**x**	**Evaluation pending filling of data gaps**		
Health Hazard Evaluation (HHE)	21	HHE Factor Levels	x	Contaminant hazard evaluation pending analytical results		
	22	HHE Three-Letter Combination Levels	x	Contaminant hazard evaluation pending analytical results		
	23	HHE Module Ratings	x	Contaminant hazard evaluation pending analytical results		
	24	HHE Module Rating	x	Contaminant hazard evaluation pending analytical results		
MRS Priority	**25**	**MRS Priority (Based on Highest Hazard Evaluation Module Rating)**	**x**	**Evaluation pending filling of data gaps**		

To be completed by USACE once all data gaps are filled.

Munitions Response Site Prioritization Protocol (MRSPP) Data Gaps
32 CRF Part 179

Installation: **Camp Abbot**
AOC: **Anti-Tank Range**
RMIS Range ID: **F10OR0041**

Module	Table No.	Table Description	Data Gap	Potential Source of Information to Fill Data Gap	No Data Gap	Description of Known Data
Explosive Hazard Evaluation (EHE)	1	Munitions Type			x	2.36-in anti-tank and practice rockets; anti-tank and practice rifle grenades
	2	Source of Hazard			x	Gunnery, artillery range
	3	Location of Munitions			x	Suspected historical evidence
	4	Ease of Access			x	No barrier
	5	Status of Property			x	Non-DoD control
	6	Population Density			x	< 100 persons per square mile
	7	Population Near Hazard	x	0 inhabited structures w/in 2 miles		
	8	Activities/Structures			x	Agricultural - livestock grazing
	9	Ecological and/or Cultural Resources	x	State Historical Preservation Office		
	10	**EHE Module Score**	**x**	**Evaluation pending filling of data gaps**		
Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)	11	CWM Configuration			x	Historical evidence indicates that CWM are not present
	12	Sources of CWM			x	Historical evidence indicates that CWM are not present
	13	Location of CWM			x	Historical evidence indicates that CWM are not present
	14	Ease of Access			x	No barrier
	15	Status of Property			x	Non-DoD control
	16	Population Density			x	< 100 persons per square mile
	17	Population Near Hazard	x	0 inhabited structures w/in 2 miles		
	18	Activities/Structures			x	Agricultural - livestock grazing
	19	Ecological and/or Cultural Resources	x	State Historical Preservation Office		
	20	**CHE Module Score**	**x**	**Evaluation pending filling of data gaps**		
Health Hazard Evaluation (HHE)	21	HHE Factor Levels	x	Contaminant hazard evaluation pending analytical results		
	22	HHE Three-Letter Combination Levels	x	Contaminant hazard evaluation pending analytical results		
	23	HHE Module Ratings	x	Contaminant hazard evaluation pending analytical results		
	24	HHE Module Rating	x	Contaminant hazard evaluation pending analytical results		
MRS Priority	**25**	**MRS Priority (Based on Highest Hazard Evaluation Module Rating)**	**x**	**Evaluation pending filling of data gaps**		
	To be completed by USACE once all data gaps are filled.					

Munitions Response Site Prioritization Protocol (MRSPP) Data Gaps
32 CRF Part 179

Installation: **Camp Abbot**
AOC: **Demolition Area**
RMIS Range ID: **F10OR0041**

Module	Table No.	Table Description	Data Gap	Potential Source of Information to Fill Data Gap	No Data Gap	Description of Known Data
Explosive Hazard Evaluation (EHE)	1	Munitions Type	x	Reconnaissance of area		Detonating cord, Dynamite, TNT, Detonators, Blasting caps, Fuses, Boosters, Bursters
	2	Source of Hazard			x	Demolition training range
	3	Location of Munitions			x	Suspected historical evidence
	4	Ease of Access			x	No barrier
	5	Status of Property			x	Non-DoD control
	6	Population Density			x	< 100 persons per square mile
	7	Population Near Hazard	x	0 inhabited structures w/in 2 miles		
	8	Activities/Structures			x	Agricultural - livestock grazing
	9	Ecological and/or Cultural Resources	x	State Historical Preservation Office		
	10	**EHE Module Score**	**x**	**Evaluation pending filling of data gaps**		
Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)	11	CWM Configuration			x	Historical evidence indicates that CWM are not present
	12	Sources of CWM			x	Historical evidence indicates that CWM are not present
	13	Location of CWM			x	Historical evidence indicates that CWM are not present
	14	Ease of Access			x	No barrier
	15	Status of Property			x	Non-DoD control
	16	Population Density			x	< 100 persons per square mile
	17	Population Near Hazard	x	0 inhabited structures w/in 2 miles		
	18	Activities/Structures			x	Agricultural - livestock grazing
	19	Ecological and/or Cultural Resources	x	State Historical Preservation Office		
	20	**CHE Module Score**	**x**	**Evaluation pending filling of data gaps**		
Health Hazard Evaluation (HHE)	21	HHE Factor Levels	x	Contaminant hazard evaluation pending analytical results		
	22	HHE Three-Letter Combination Levels	x	Contaminant hazard evaluation pending analytical results		
	23	HHE Module Ratings	x	Contaminant hazard evaluation pending analytical results		
	24	HHE Module Rating	x	Contaminant hazard evaluation pending analytical results		
MRS Priority	**25**	**MRS Priority (Based on Highest Hazard Evaluation Module Rating)**	**x**	**Evaluation pending filling of data gaps**		
	To be completed by USACE once all data gaps are filled.					

Munitions Response Site Prioritization Protocol (MRSPP) Data Gaps
32 CRF Part 179

Installation: **Camp Abbot**
AOC: **Mortar Range**
RMIS Range ID: **F10OR0041**

Module	Table No.	Table Description	Data Gap	Potential Source of Information to Fill Data Gap	No Data Gap	Description of Known Data
Explosive Hazard Evaluation (EHE)	1	Munitions Type			x	60mm and 81mm mortars
	2	Source of Hazard			x	Mortar range
	3	Location of Munitions			x	Suspected historical evidence
	4	Ease of Access			x	No barrier
	5	Status of Property			x	Non-DoD control
	6	Population Density			x	< 100 persons per square mile
	7	Population Near Hazard	x	0 inhabited structures w/in 2 miles		
	8	Activities/Structures			x	Agricultural - livestock grazing
	9	Ecological and/or Cultural Resources	x	State Historical Preservation Office		
	10	**EHE Module Score**	**x**	**Evaluation pending filling of data gaps**		
Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)	11	CWM Configuration			x	Historical evidence indicates that CWM are not present
	12	Sources of CWM			x	Historical evidence indicates that CWM are not present
	13	Location of CWM			x	Historical evidence indicates that CWM are not present
	14	Ease of Access			x	No barrier
	15	Status of Property			x	Non-DoD control
	16	Population Density			x	< 100 persons per square mile
	17	Population Near Hazard	x	0 inhabited structures w/in 2 miles		
	18	Activities/Structures			x	Agricultural - livestock grazing
	19	Ecological and/or Cultural Resources	x	State Historical Preservation Office		
	20	**CHE Module S core**	**x**	**Evaluation pending filling of data gaps**		
Health Hazard Evaluation (HHE)	21	HHE Factor Levels	x	Contaminant hazard evaluation pending analytical results		
	22	HHE Three-Letter Combination Levels	x	Contaminant hazard evaluation pending analytical results		
	23	HHE Module Ratings	x	Contaminant hazard evaluation pending analytical results		
	24	HHE Module Rating	x	Contaminant hazard evaluation pending analytical results		
MRS Priority	**25**	**MRS Priority (Based on Highest Hazard Evaluation Module Rating)**	**x**	**Evaluation pending filling of data gaps**		
	To be completed by USACE once all data gaps are filled.					

Munitions Response Site Prioritization Protocol (MRSPP) Data Gaps
32 CRF Part 179

Installation: **Camp Abbot**
AOC: **Grenade Courts**
RMIS Range ID: **F10OR0041**

Module	Table No.	Table Description	Data Gap	Potential Source of Information to Fill Data Gap	No Data Gap	Description of Known Data
Explosive Hazard Evaluation (EHE)	1	Munitions Type			x	Mk II, M15, AN-M8, and AN-M14 Grenades; M21 Practice hand grenades
	2	Source of Hazard			x	Grenade courts
	3	Location of Munitions			x	Suspected historical evidence
	4	Ease of Access			x	No barrier
	5	Status of Property			x	Non-DoD control
	6	Population Density			x	< 100 persons per square mile
	7	Population Near Hazard	x	0 inhabited structures w/in 2 miles		
	8	Activities/Structures			x	Agricultural - livestock grazing
	9	Ecological and/or Cultural Resources	x	State Historical Preservation Office		
	10	**EHE Module Score**	**x**	**Evaluation pending filling of data gaps**		
Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)	11	CWM Configuration			x	Historical evidence indicates that CWM are not present
	12	Sources of CWM			x	Historical evidence indicates that CWM are not present
	13	Location of CWM			x	Historical evidence indicates that CWM are not present
	14	Ease of Access			x	No barrier
	15	Status of Property			x	Non-DoD control
	16	Population Density			x	< 100 persons per square mile
	17	Population Near Hazard	x	0 inhabited structures w/in 2 miles		
	18	Activities/Structures			x	Agricultural - livestock grazing
	19	Ecological and/or Cultural Resources	x	State Historical Preservation Office		
	20	**CHE Module Score**	**x**	**Evaluation pending filling of data gaps**		
Health Hazard Evaluation (HHE)	21	HHE Factor Levels	x	Contaminant hazard evaluation pending analytical results		
	22	HHE Three-Letter Combination Levels	x	Contaminant hazard evaluation pending analytical result s		
	23	HHE Module Ratings	x	Contaminant hazard evaluation pending analytical results		
	24	HHE Module Rating	x	Contaminant hazard evaluation pending analytical results		
MRS Priority	**25**	**MRS Priority (Based on Highest Hazard Evaluation Module Rating)**	**x**	**Evaluation pending filling of data gaps**		
	To be completed by USACE once all data gaps are filled.					

Munitions Response Site Prioritization Protocol (MRSPP) Data Gaps
32 CRF Part 179

Installation: **Camp Abbot**
AOC: **Burial Pit**
RMIS Range ID: **F10OR0041**

Module	Table No.	Table Description	Data Gap	Potential Source of Information to Fill Data Gap	No Data Gap	Description of Known Data
Explosive Hazard Evaluation (EHE)	1	Munitions Type			x	Light and heavy arms (.30 to .50 caliber); Grenades; 60mm and 81mm Mortars; 2.36-in Anti-tank and practice rockets; Explosives; Riot control agents; Chemical ID, Toxic gas sets; Toxic chemical munitions
	2	Source of Hazard			x	Landfill disposal area for all munitions
	3	Location of Munitions			x	Suspected historical evidence
	4	Ease of Access			x	No barrier
	5	Status of Property			x	Non-DoD control
	6	Population Density			x	< 100 persons per square mile
	7	Population Near Hazard	x	0 inhabited structures w/in 2 miles		
	8	Activities/Structures			x	Agricultural - livestock grazing
	9	Ecological and/or Cultural Resources	x	State Historical Preservation Office		
	10	**EHE Module Score**	**x**	**Evaluation pending filling of data gaps**		
Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)	11	CWM Configuration			x	Historical evidence indicates that CWM are not present
	12	Sources of CWM			x	Historical evidence indicates that CWM are not present
	13	Location of CWM			x	Historical evidence indicates that CWM are not present
	14	Ease of Access			x	No barrier
	15	Status of Property			x	Non-DoD control
	16	Population Density			x	< 100 persons per square mile
	17	Population Near Hazard	x	0 inhabited structures w/in 2 miles		
	18	Activities/Structures			x	Agricultural - livestock grazing
	19	Ecological and/or Cultural Resources	x	State Historical Preservation Office		
	20	**CHE Module Score**	**x**	**Evaluation pending filling of data gaps**		
Health Hazard Evaluation (HHE)	21	HHE Factor Levels	x	Contaminant hazard evaluation pending analytical results		
	22	HHE Three-Letter Combination Levels	x	Contaminant hazard evaluation pending analytical results		
	23	HHE Module Ratings	x	Contaminant hazard evaluation pending analytical results		
	24	HHE Module Rating	x	Contaminant hazard evaluation pending analytical results		
MRS Priority	**25**	**MRS Priority (Based on Highest Hazard Evaluation Module Rating)**	**x**	**Evaluation pending filling of data gaps**		

Munitions Response Site Prioritization Protocol (MRSPP) Data Gaps
32 CRF Part 179

Installation: **Camp Abbot**
AOC: **Chemical Training Area**
RMIS Range ID: **F10OR0041**

Module	Table No.	Table Description	Data Gap	Potential Source of Information to Fill Data Gap	No Data Gap	Description of Known Data
Explosive Hazard Evaluation (EHE)	1	Munitions Type			x	AN-M8 and M15 Smoke grenade; AN-M14 Incendiary grenade; Tear gas M1; Chemical ID, Toxic Gas Set M1and M2; Toxic chemical munitions
	2	Source of Hazard			x	Chemical identification area
	3	Location of Munitions			x	Suspected historical evidence
	4	Ease of Access			x	No barrier
	5	Status of Property			x	Non-DoD control
	6	Population Density			x	< 100 persons per square mile
	7	Population Near Hazard	x	0 inhabited structures w/in 2 miles		
	8	Activities/Structures			x	Agricultural - livestock grazing
	9	Ecological and/or Cultural Resources	x	State Historical Preservation Office		
	10	**EHE Module Score**	**x**	**Evaluation pending filling of data gaps**		
Chemical Warfare Materiel (CWM) Hazard Evaluation (CHE)	11	CWM Configuration			x	Historical evidence indicates that CWM are not present
	12	Sources of CWM			x	Historical evidence indicates that CWM are not present
	13	Location of CWM			x	Historical evidence indicates that CWM are not present
	14	Ease of Access			x	No barrier
	15	Status of Property			x	Non-DoD control
	16	Population Density			x	< 100 persons per square mile
	17	Population Near Hazard	x	0 inhabited structures w/in 2 miles		
	18	Activities/Structures			x	Agricultural - livestock grazing
	19	Ecological and/or Cultural Resources	x	State Historical Preservation Office		
	20	**CHE Module Score**	**x**	**Evaluation pending filling of data gaps**		
Health Hazard Evaluation (HHE)	21	HHE Factor Levels	x	Contaminant hazard evaluation pending analytical results		
	22	HHE Three-Letter Combination Levels	x	Contaminant hazard evaluation pending analytical results		
	23	HHE Module Ratings	x	Contaminant hazard evaluation pending analytical results		
	24	HHE Module Rating	x	Contaminant hazard evaluation pending analytical results		
MRS Priority	**25**	**MRS Priority (Based on Highest Hazard Evaluation Module Rating)**	**x**	**Evaluation pending filling of data gaps**		

Camp Abbott HRS Data Gaps

Information required to complete the MEC-HRS data collection form:

Item	Number	Comment – Missing Data Element
1	1.8	Confirm the latitude / longitude of potential source(s) and the accuracy of the information (in meters)
2		Source scale (i.e., 1:24,000, etc.)
3	1.12	Site Permits
4	2.4	Confirm if there are other NPL sites within 1 mile of the site
5	5.3	Population within 1 mile, within 4 miles
6	6	Water use (GW within 4 miles, SW within 15 miles)
7	6.1	Total drinking water population served
8	6.2	Type of drinking water supply system (GW or SW?)
9	6.3	Other water uses of GW within 4 miles
10	6.5	Surface water uses
11	6.6	Type of SW adjacent to (within 2 miles) of the site
12	8.1	Types of action(s) that have occurred at or near the site
13	8.2	Who did the action? (EPA, Private parties, other, etc.?)